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The Canadian Geographical Journal will be sent to each member of the Society in good standing. Membership in the Society is open to any one interested in geographical matters. The annual fee for membership is three dollars in Canada.

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CANADIAN GEOGRAPHICAL JOURNAL

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The British standard of spelling is adopted substantially as used by the Dominion Government and taught in most Canadian schools, the precise authority being the Oxford Dictionary as edited in 1936.

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Photo by R. W. Harrington

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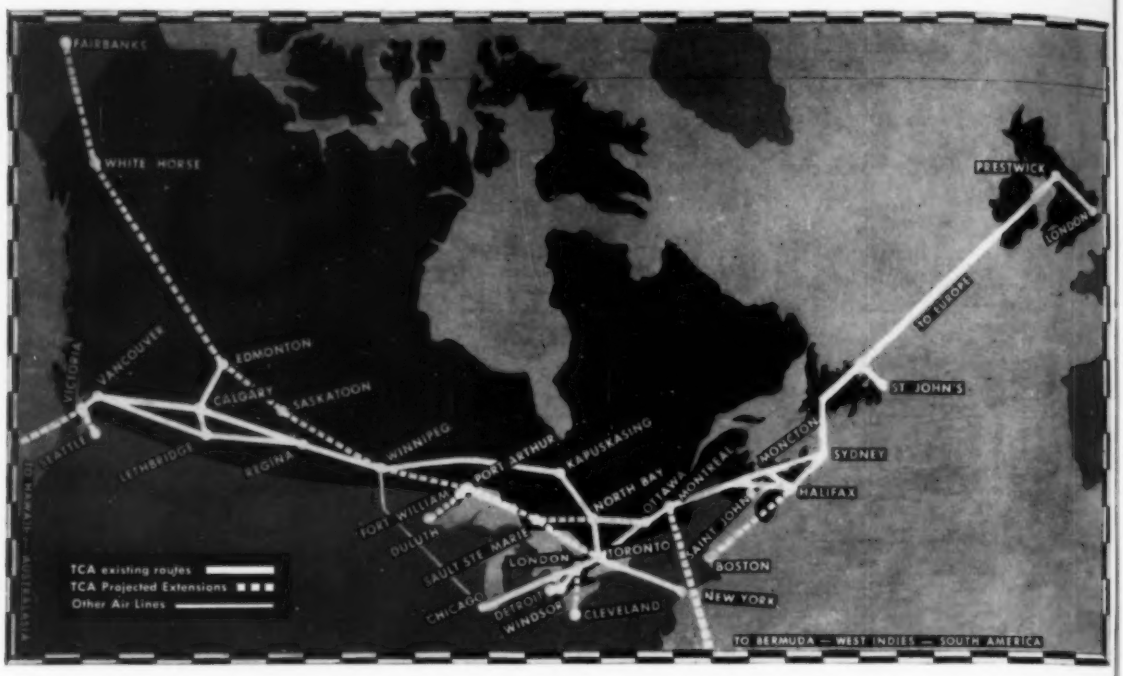


Trans-Canada Air Lines

by ROBERT H. AYRE

NEXT SPRING, Trans-Canada Air Lines will be ten years old. It was in April, 1937, that the Dominion's national air service was created by Act of Parliament. For a youngster that had scarcely hit its stride when Canada went to war, that was nurtured in a time of restrictions, and shortages of both men and materials, its growth has been phenomenal. Scheduled flights across the continent between Montreal and Vancouver had been in operation only a few months when the young air line (designed for the development of a country at peace, planned to assist in the integration of communities scattered across 3,000 miles) became a powerful instrument of war. The demands made upon it were great, but it grew in strength and efficiency, maintaining high standards of service, improving and increasing its schedules, planning for expansion when the war ended; and it brought renown to itself, reflecting credit on the people who made and own it.

When it began, T.C.A. had one line, 122 miles long, from Vancouver to Seattle. Today it operates over 5,299 miles of routes, spanning the Dominion from sea to sea, reaching north and south, and its planes fly more than 10,000,000 miles a year. This does not take into account the service it operates across the Atlantic. Moreover, the air line is still growing. H. J. Symington, C.M.G.,

K.C., its President, estimates that in 1946 Trans-Canada's route milage will be expanded by 67 per cent. In the near future will come extensions to the West Indies and South America and to the Pacific area. T.C.A. has been designated by the Government as the agency to operate all transcontinental and international services.

To-day the main-line route stretches all the way from Halifax to Victoria, taking in Moncton, Montreal, Ottawa, Toronto, North Bay, Winnipeg, Regina, Lethbridge and Vancouver. In addition, Halifax is linked, by subsidiary routes, with Sydney and also Blissville, which serves Fredericton and Saint John. T.C.A. connects Newfoundland with Canada by way of St. John's and Moncton. It has regular flights between Toronto and New York and links Toronto, London and Windsor; a service is also maintained between Lethbridge, Calgary and Edmonton. All the cities mentioned that do not happen to be on the main transcontinental line feed into it, so that passengers, mails and express originating, for example, in Edmonton, can go all the way to New York by T.C.A. It operates four daily transcontinental flights in each direction and numerous inter-city flights.

Trans-Canada planes make five return trips weekly across the Atlantic, between Montreal and Prestwick, Scotland, and will further increase frequency this summer. This enterprise was undertaken for the Government three years ago, primarily to speed mails to and from the Canadian forces and prisoners of war overseas, to carry medical supplies and other urgent war necessities, and to transport high-priority passengers on war missions. While this service is still operated for the Government, which owns the six Lancaster aircraft on this run, T.C.A. is now offering transportation to the public as well as carrying mails and express.

At the end of last year, T.C.A. had 28 aircraft: 14 Lockheed Lodestars, each equipped with two Pratt & Whitney twin-row Wasp engines of 1,200 horsepower; 11 Lockheed 14-08 aircraft, with similar engines, and three Douglas DC-3 aircraft, equipped with twin Wright Cyclone engines of 1,200 horsepower, and carrying 21 passengers. The three Douglases are the first of an order for 24. Delivery of the other 21 will be completed this year. They will have twin Pratt & Whitney Wasps.

Mention should, perhaps, be made here of the four-engine 40-passenger aircraft now being built in the factory of Canadair Limited near Montreal under close T.C.A. supervision. "This", says Mr. Symington, "is a major programme of Canadian manufacture, intended to provide T.C.A. with the best in flight equipment." The 40-passenger liners will be used in transcontinental and international services. The airframe design, based on the Douglas DC-6, incorporates important modifications made by T.C.A. engineers to meet Canadian conditions. The four liquid-cooled Rolls-Royce engines of each aircraft are of British manufacture.

Operations headquarters of T.C.A. are at Winnipeg and here is situated the engineering and maintenance base, staffed by skilled technicians and equipped with the most modern machines and instruments for the checking, testing and overhauling of aircraft and parts. All the company's aircraft

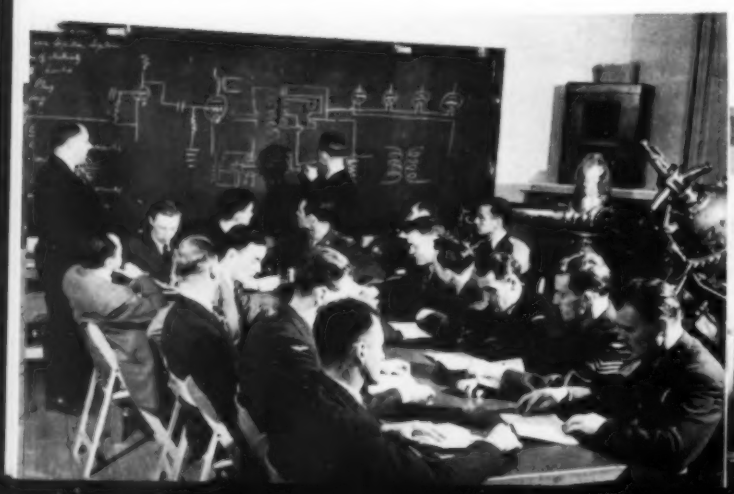
Three types of T.C.A. aircraft—left, a 14-passenger Lodestar; centre, a 21-passenger DC-3; right, the 40-passenger four-engine airliner now being built at Montreal for over-ocean and transcontinental routes.

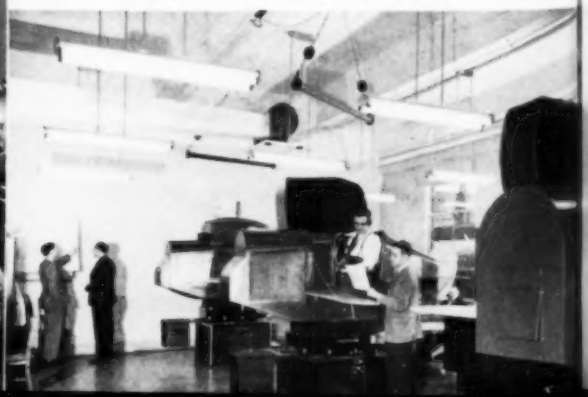
go through a well-proved system of checks which are based on flying hours and become progressively thorough until in the last examination the aircraft is practically taken apart and rebuilt. For three years, the air line, under contract to the Department of Munitions and Supply, overhauled military aircraft, engines, propellors, instruments and accessories, handling a heavy volume of this war work in addition to the routine work on its own fleet. A major maintenance base was established last year at Moncton and the company has extensive shops at Montreal, where nearly 900 employees not only maintain the Lancasters used in the Atlantic operation, but service and maintain the Liberators used in the trans-Atlantic crossings of the British Overseas Airways Corporation. Throughout the war this work played an important part in the flying of the return ferry service. The experience gained by the large staff will be invaluable as the T.C.A. Atlantic service develops.

Through research and experiment, T.C.A. men have worked out many devices and methods which have been adopted by other air lines—and these advances are not confined to shop practice. For example, T.C.A. communications experts are to the forefront in electronic development. An experimental radar station has for some time been established at Winnipeg for the study of radar application to civil air operations. This was the first project of its kind undertaken by a commercial air line. Very high frequency ground radio installations for the trans-Atlantic service have been completed in Eastern Canada and Newfoundland, and Loran is being employed, again for the first time by a non-military air service. The first frequency-modulated radio circuit to be applied to air line operations in Canada was installed several years ago between Vancouver and Victoria. The central reservations control system at Toronto for the speedy handling of passenger bookings has been a model for other air lines. T.C.A. has developed new flight procedures with a view to reducing fuel consumption and prolonging the life of equipment, and has made a thorough study of icing and anti-icing, of heating and ventilation and other matters affecting the efficiency of flight and the comfort of passengers. Working both on its own and in co-operation with the National Research Council and the Royal Canadian Air Force, it has, in many ways, made major contributions to aeronautical science.

At the end of last year, Trans-Canada Air Lines had a staff numbering 3,272, of which 1,161 had served with the Armed Forces. It is the air line's policy in engaging new personnel to employ only those who have had military service. During the war, 325 T.C.A. employees enlisted in Canada's Armed Forces and 19 lost their lives.

Women made a splendid contribution to T.C.A.'s activities during the war. They were a credit to the company and to themselves as radio operators, as cargo handlers and chauffeurs, as passenger agents, in the overhaul shops and in many other capacities, in addition to being clerical workers and stewardesses. In 1943, women made up 35 per cent of the total staff. With the return of the men from the war, their numbers are being reduced, and last year they comprised 23 per cent of the personnel.





T.C.A. has been described as "a university of the air". Classes for pilots, radio operators, mechanical personnel, stewardesses, passenger agents and others are almost continuously in session. The Link Trainer room, where pilots "fly" without leaving the ground, is seen at right.

Most of the training of pilots, radio operators, passenger agents, traffic personnel, stewardesses and others takes place at Winnipeg, where schools are almost continuously in session. Last year, 76 former R.C.A.F. pilots studied the techniques of civil air transport and were trained for air line duty, bringing the total to 105. These men, many of whom were decorated for distinguished war service overseas, are of high calibre and came to Trans-Canada with real flying experience. The average R.C.A.F. pilot had to go through at least six months of intensive training before he got his wings. If he joined the Bomber Command, he had to make 30 sweeps across the Channel before he completed one tour of operations. If he was on the Coastal Patrol, he did more. The duties of fighter pilots were counted in hours and the average was 200. In the early days of the war, many airmen completed two tours, continually running the gauntlet of enemy aircraft and flak. But even those of the highest attainment go back to school when they join T.C.A., for scheduled air line flying is different from military flying. Most of the pilots, for example, had never done any navigating. In the T.C.A. schools they learn to fly the beam and study flight planning, the ways of the weather and the different types of aircraft. After six or seven weeks in class and in the Link Trainer they go aloft on instruction flights in T.C.A. aircraft; subsequently, they have to be co-pilots or first officers for an average of 18 months before qualifying as captains.

Trans-Canada has reason to be proud of its men and women, both in the air and on the ground; and they, in turn, are proud of their young air line. Their morale is high. They look upon themselves as members of a family doing a good job, and while they are essentially specialists in the various departments that make up an air line they have a sense of the whole, of the interrelationship of the parts. Staff meetings for the exchange of knowledge and ideas have been a practice of the air line since it was first organized, while a monthly staff magazine, co-operative committees, which encourage individuals to make suggestions to the management, and a recreational association are contributing factors in developing and maintaining *esprit de corps*.

T.C.A. is the outcome of a long period of experiment and cultivation, for Canada has been air-minded since the beginning of the air age. Her interest in aviation goes back to the balloons of the seventies, when the Wright brothers were unfledged youngsters. Even in those days, Canadians had an eye on the future. The pioneer in aeronautical research in Canada, following the balloon experimentalists, was W. R. Turnbull, to whom aviation is greatly indebted, not only for his invention of a wind tunnel in 1902, but also for other major contributions, including the controllable pitch propeller.

For some years, Dr. Alexander Graham Bell had been experimenting with kites and airscrews at his summer home near Baddeck, Nova Scotia, before he formed the Aerial Experiment Association in 1907. It consisted of himself, Glen Curtiss (who was then building motorcycle engines at Hammondsport, N.Y.), Lieutenant Selfridge of the United States Army (later killed flying with the Wrights near Washington), and F. W. Baldwin and J. A. D. McCurdy, graduates in practical science of the University of Toronto. McCurdy had played in Bell's laboratory as a child, growing up to help the inventor in his work, and when he graduated he naturally wanted to carry on with the new science which so fascinated him. He brought Baldwin, a fellow student, to Baddeck. The enterprise was financed, with a working capital of $35,000, by Mrs. Bell.

The first recorded flight made in the Empire by a heavier-than-air machine carrying a passenger was in December, 1907. The machine was a tetrahedral kite called the "Cygnet", and a steam tug provided the power. The passenger was Lieutenant Selfridge. Taking off from Bras d'Or Lake, he reached an altitude of 170 feet.

Bell continued his experiments with kites, and the other members of the association designed gliders with motors. Their first aeroplane, built at the Curtiss factory and equipped with skis, was flown over Lake

Keuka, N.Y., in March, 1908. The pilot was Baldwin—the first British subject to fly. Baldwin's "Red Wing" flew successfully in May and later in the season Curtiss, in his "June Bug", won the *Scientific-American* trophy for the first heavier-than-air machine to fly one kilometer.

With his long beard blowing in the winter wind, Dr. Bell stood on the ice of Baddeck Bay on February 23, 1909, and watched McCurdy take his "Silver Dart" 30 feet into the air and fly it half a mile at 40 miles an hour. This was the first flight of a flying machine in Canada—some say in the British Empire—and aviation in the Dominion was well on its way. A few days later, McCurdy covered 8 miles in 11 minutes and 15 seconds. "The Silver Dart" was recognized as an advance on any aircraft previously flown. Its three-wheel under-carriage and its tapered wings were notable features, but even more important was the use of control by ailerons.

The association was dissolved at the end of March, but McCurdy and Baldwin carried on their activities and others began to come forward. A flying meet was held in Montreal in 1910 and Jacques de Lesseps flew at Montreal and Toronto in his Blériot monoplane; an aeroplane was built and flown at the Pacific Coast in the same year. McCurdy flew from Key West, Florida, to Cuba in 1911. This was the longest overseas flight up to that time and it was not to be repeated until 1928, when Lindbergh opened the air mail service between Florida and Cuba. In the next few years aircraft went on improving and flying experimentation gradually developed into a science.

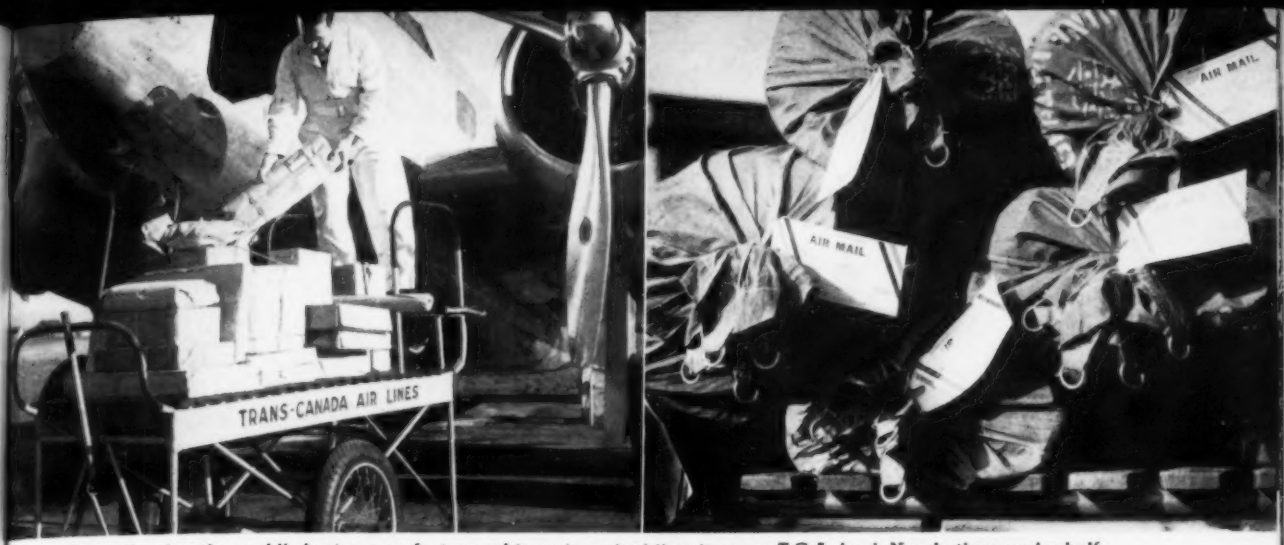
Trans-Canada Air Lines did not materialize until nearly 30 years after the "Silver Dart" flew at Baddeck, but there was much aeronautical activity during those three decades. Canadian airmen made an illustrious name for themselves and their country by their exploits in the British Services (there was no Canadian air force) during World War I. They were "bitten by the bug", and many of those who came home after 1918 decided to make a career of aviation.

Some of them went into exhibition flying, joy-riding and teaching, but in time the airmen found other outlets for their ambitions. As early as 1915, Dr. Charles Camsell, Deputy Minister of Mines and Resources, was enquiring about flying boats to make things easier for scientists working in the Far North. This use of aircraft in exploration did not come for a few years, because Canada was deeply involved in war, but the armistice was scarcely signed when she began pioneering in forestry surveys and fire protection from the sky, in aerial photography and mapping. Forestry patrols were started in Quebec in 1919, and the idea rapidly spread to other provinces. Canadians began to realize the value of wings in reaching the outposts of their vast northern wilderness. When crude oil was discovered at Fort Norman in the Northwest Territories in 1921, the Imperial Oil Company bought two Junkers planes to facilitate communication.

"The story of this pioneer effort is an epitome of the difficulties overcome in later years by hard work and careful planning", as J. A. Wilson, former Director of Air Services, Department of Transport, and a Director of T.C.A., has pointed out in an historical survey. "Intense cold, Arctic blizzards, rough landings in unknown country, inadequate supplies and unsuitable equipment all were mastered by hard work and indomitable perseverance. A new propeller was built on one occasion at a Hudson Bay post from oak sleigh boards and glue made on the spot from moose hide."

The use of air transport in the North became firmly established. Many rich mining centres, far from road and railway and accessible only by canoe in summer and dogsled in winter, owe their existence and development to the aeroplane. One interesting, and even romantic, use of aircraft was the spotting of seal herds from flying boats for the Newfoundland sealing fleet, in 1924-26.

The first passenger and freight service in Canada was established in the Rouyn mining area of Quebec in 1924. Flying boats, fitted with skis in winter, carried 1,000 passengers, 78,000 pounds of freight and 15,000 letters and telegrams in the first six months.



Air mail makes the world's business go faster, and is an important item in every T.C.A. load. Nearly three and a half million pounds were carried in 1945, plus nine hundred thousand pounds in the trans-Atlantic service. Whether they be flowers, films, documents, medical supplies or machine parts, air express transports them with maximum dispatch. This service, which has become all-important to Canadian economy, has grown steadily since T.C.A. started it.

Canada went into the air freight business on a large scale. Pioneer flying in Canada was "bush flying"—and it was bush flying that put Canada into the front rank of world aviation. For years, the Dominion carried more freight by air than any other country—indeed, more than several of the greatest and most advanced countries combined. It was subsequently exceeded only by the Soviet Union. In one year, 1938, for example, air freight in Canada totalled 27,000,000 pounds.

Inter-city air mail service was being studied as far back as 1920, but it was ten years before this could actually be put into effect. In the meantime, mail services to outlying communities were rapidly developing. Flying clubs sprang up in most of the cities, as well as in many smaller communities. As a result of this enthusiasm and activity, when the Civil Aviation Branch of the Government began its transcontinental airway survey in 1928, it found many airports and landing fields already established or in the process of formation.

Without waiting to complete installations in Northern Ontario and in the Rockies, the Government went ahead in the easier terrain of the prairies, leasing and improving properties for intermediate landing fields, and installing lighting, radio and meteorological services. In 1930, a nightly air mail service went into effect between Winnipeg and Edmonton by way of Calgary, and later by Lethbridge and Calgary. At the same time, daily air mail service was established from Moncton to Montreal, Kingston, Toronto, Hamilton, Brantford, London, Windsor and Detroit. Arrangements were made with the United States air mail service for the carriage of mails between Detroit and Pembina, south of Winnipeg. (This could not be called a direct route, but it did connect Moncton and Edmonton by air.)

The inter-city air mail service was discontinued in the spring of 1932 owing to the depression. It would, however, have been poor economy not to maintain the sections of the airway which had been completed, and these were not neglected. In addition, surveys through the mountains were carried on, and in 1933 construction was begun in British Columbia, Ontario, Quebec and the Maritime Provinces to provide employment for thousands of single, homeless men.

With the completion of the airway, or the better part of it, the time had come for the organization of Trans-Canada Air Lines. T.C.A. grew out of the need for a swift, modern system of transportation between communities scattered across an area of more than 3,000 miles, out of a vision of a more closely integrated nation—and a nation playing an increasingly important part in the affairs of the world.

Canada's national air service was incorporated by Act of Parliament in April, 1937. The authorized capital of the corporation was $5,000,000, divided into shares of $100 each. These were to be offered for subscrip-

tion to the Canadian National Railway Company at par, and there were limitations as to the disposition of them. Under the terms of the Trans-Canada Air Lines Act, 1937, the railway must retain the majority of the shares; they were not transferable except to persons engaged in or interested in aviation and approved by the Minister of Transport; they could not be held by any person other than a British subject resident in Canada or a corporation incorporated under the laws of Canada; and the Minister of Transport might at any time, with the approval of the Governor in Council, acquire all of the shares at book value. By amendment to the act in the fall of 1945, the capitalization was increased to $25,000,000. The Canadian National Railways remains the only shareholder.

The act distinguished between the words *air line* and *airway*—a distinction not always understood by the public. T.C.A. is an air line, supplying its own equipment, hangars and other buildings, and its own communications. It operates over an airway, which is the responsibility of the Government, and which includes airports (some of these are municipally owned), emergency landing fields, lights, radio ranges and a meteorological service—all operated by the Air Services Branch of the Department of Transport.

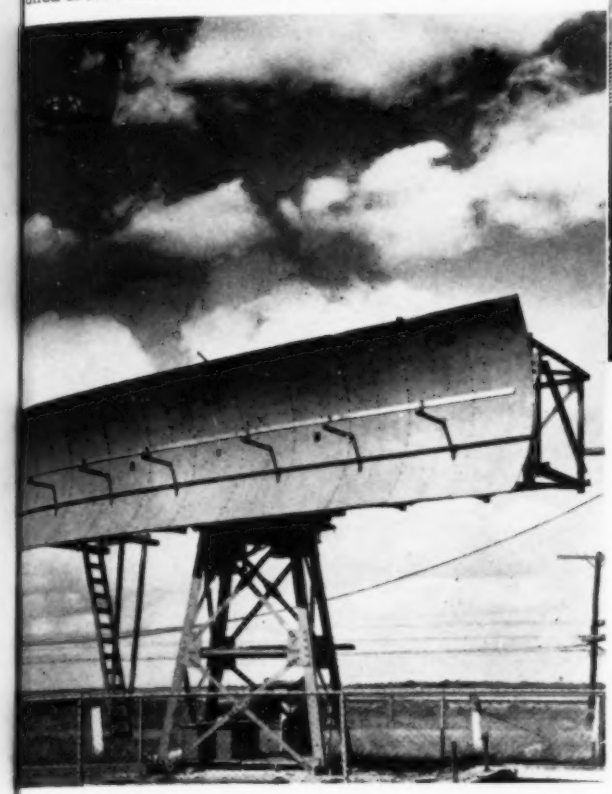
To cover deficits in the first few years of organization, subsidies were paid by the Government, but the company had a surplus of half a million dollars in 1940 and surpluses were realized in every year following.

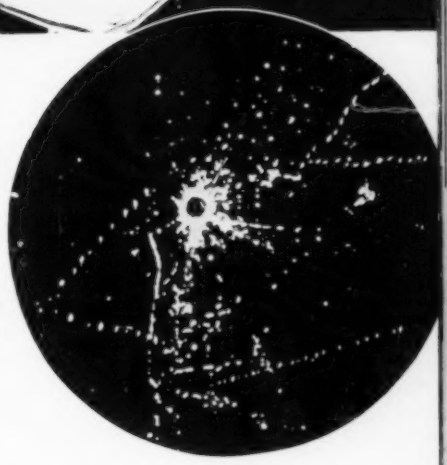
Trans-Canada's mail contract was executed in December, 1938. The rate was fixed at 60 cents a mile for the initial period, and this stood until 1941, when it was reduced to 48.16 cents. In 1942 it was 45.57 cents; in 1943 it was 42.90 cents; in 1944, 42.03 cents and in 1945 it was 41.98 cents.

Legislation passed in the fall of 1945 made a basic change in the structure of the air line. The new mail contract, which went into effect on April 1 of 1946, is on a pound-mile basis instead of a milage basis. For the first fiscal year, T.C.A.'s compensation will be 1.5 mills per pound-mile. In the second year, it will be reduced to 1.3 mills; in the third, to 1.1 mills, and thereafter it will be .9 mills. The older method was regarded as desirable during the company's early years but as the air line expanded it became unsuitable. It gave the Post Office

That great military secret, Loran (a combination of the first two letters of "long", the first two letters of "range" and the first letter of "navigation"), is a long-range radio-navigational system based on radar-pulse technique, and is being used for the first time by any commercial air line in the world by Trans-Canada Air Lines on the North Atlantic service which the company operates for the Dominion Government. Experience in its use was obtained by the air line from the R.C.A.F. Loran is the only device of all long-range navigational aids to aviation which can always be depended upon to give true indications. With it, accurate fixes are generally obtainable well over 800 miles from the transmitting stations in day-time, and over 1,400 miles at night, with an accuracy better than that of celestial. It is almost independent of weather conditions and no transmission from the aircraft is required. Without the use of compass, chronometer, or any other radio or radar set, fixes can be obtained in less than a minute, and no calculation is necessary. By this system, the time of travel of radio waves from two ground stations to the aircraft is measured, and from this the distance can be obtained. These photographs show a navigator operating the equipment on a T.C.A. Lancaster in flight over the Atlantic, and a close-up of the complete mechanism.

Born of war, radar now becomes the servant of peaceful civil aviation. T.C.A., one of the first air lines in the world to investigate its uses, installed an experimental station with the collaboration of the National Research Council and the R.C.A.F.





At left:—The rotating antenna which transmits radio waves and then catches them on the rebound from whatever they may strike. At right:—An operator at the cathode ray indicator, or radar screen (similar to that used in television) views a flock of geese (seen in circle).

control over frequencies and times of operation. That control is now removed and, while protection against deficits through increased mail rates is also removed, the company is now able to control fully its operations. All schedules may carry mail and there is no commitment to transport any set amount. The company thus has greater flexibility in arranging its loads and is free to seek the maximum passenger sales. The trans-Atlantic mail rate is $7.75 a pound and 75 cents a pound for carriage by air of "surface" mail for the troops overseas.

The management of Trans-Canada Air Lines is vested in a Board of Directors of seven, four elected by the shareholders and three appointed by the Governor in Council. The President of T.C.A. is H. J. Symington, C.M.G., K.C., and the other members of the Board of Directors elected by the shareholders are: Wilfrid Gagnon, C.B.E., and J. A. Northey, Directors of Canadian National Railways, and R. C. Vaughan, C.N.R. Chairman and President. Directors appointed by the Governor in Council are: C. P. Edwards, O.B.E., Deputy Minister of Transport; J. A. Wilson; and George Herring, Chief Superintendent of Air and Land Mail Services, Post Office Department.

Trans-Canada Air Lines' first operations vice-president was the late Philip G. Johnson, called to Canada from the United States because of his wide experience in large-scale transcontinental flying operations. He brought with him other Americans of outstanding ability, such as D. B. Colyer and O. T. Larson, both of whom succeeded him in the office of vice-president. To-day the position is held by William F. English, whose transportation career began with the Canadian National, and all the executive officers are now Canadians, many of whom began as pilots.

While T.C.A. controls its own operations, the C.N.R. lends assistance. In order to avoid duplication and provide for economical administration, the two companies share some of their officers: the air line's secretary, treasurer, comptroller, director of public relations, chief architect, express services gen-

eral manager and chief medical officer, for instance, hold the same positions in the Canadian National Railways.

Trans-Canada is divided into three zones of operation: the Eastern Region, the Central Region and the Western Region. Each of these has its own operations manager, reporting to the system general manager of operations at Winnipeg. The trans-Atlantic service also has an operations manager, who has jurisdiction over overseas bases. Regional traffic managers are responsible for sales promotion in their respective territories and report to a general traffic manager, at Winnipeg.

The regional operations managers direct the air line's operational activity throughout the wide geographical areas over which they hold jurisdiction, and are essentially administrative officers. Operational policy stems largely from Winnipeg, where the vice-president of operations is located, as well as the general managers of operations and of traffic, and the departmental directors who establish procedures and correlate the work of the various specialized groups within the air line—maintenance and overhaul, engineering, flight operations, flight development, communications and electronic development, passenger service, cargo service and training. The organization is seen, therefore, to be one of considerable administrative decentralization, but with operational policy the concern of headquarters staff.

T.C.A. started in a modest way, taking over an existing air line that operated over the 122 miles between Vancouver and Seattle a few months after its incorporation; this service was discontinued in 1941. In 1938 a limited mail and express service went into effect between Montreal and Toronto and Vancouver, and between Lethbridge and Edmonton. The maintenance and overhaul base was established at Winnipeg; hangars were completed at Winnipeg and Lethbridge, and another was begun at Toronto; stations with complete radio facilities were opened. Within the year the staff grew from 71 employees to 332. To the fleet of five 10-passenger Lockhead Electras were added nine Lockheed Fourteens.

Trans-Canada's first big year was 1939. In the spring, regular passenger, mail and express schedules began between Montreal and Vancouver and between Lethbridge, Calgary and Edmonton. Air mail service, on a daylight schedule, was extended to Moncton in November. The Electras were sold and six more of the larger Fourteens were acquired, bringing the fleet up to fifteen. The Toronto hangar was completed and another erected at Montreal; the Winnipeg hangar and shops were also extended.

Early in 1940, planes were carrying passengers and mail across the continent between Moncton and Vancouver. The Toronto-London-Windsor line was opened in the summer. A second daily flight went into effect on the trans-continental route and another daily trip was added between Montreal, Ottawa and Toronto. Six Lockheed Lodestars were purchased. A hangar was completed and opened at Moncton. Shop facilities at Winnipeg were expanded to provide the additional accommodation required to take care of overhaul work on military aircraft.

Service was extended to Halifax in April, 1941, and to New York from Toronto in May. A hangar was completed at Montreal's new airport at Dorval, while facilities at Winnipeg and Toronto were further enlarged. Conversion, overhaul and maintenance of aircraft used in the Atlantic return ferry service was undertaken at Montreal.

Extensions of service in 1942 included lines to Sydney, N.S., and St. John's, Newfoundland. Six more Lodestars were acquired and the Fourteens were improved by installation of 1,200-horsepower Wasp engines in place of 850-horsepower Hornets. T.C.A.

Plane's-eye views of their magnificent country are now familiar to Canadians. Shown on these two pages are Halifax (lower left) and (reading left to right) an Ontario landscape Vancouver, Toronto, the Bow River near Calgary, Montreal, Edmonton, Ottawa and Winnipeg.

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undertook the operation of the new engine shop erected at Winnipeg by the Department of Munitions and Supply for the overhaul of military equipment. This year saw T.C.A. crews participating in trans-Atlantic flights in preparation for the service the air line was to be called upon to operate—a service which began in July, 1943.

The air line's main tasks in 1943 were the improvement and intensification of Canadian and Newfoundland services, the carrying out of a heavy programme of military aircraft overhaul, and the development of the Government's trans-Atlantic service. The transcontinental route was extended to the Vancouver Island terminal at Patricia Bay, giving direct service to Victoria and other communities. Facilities were increased at Toronto and Moncton and a new hangar, service building and annex were nearing completion at Winnipeg. To keep abreast of the growth of traffic and provide improved service to the public, passenger offices in various parts of the system were enlarged.

The 1944 annual report began with these words: "In its seventh year of public service, Trans-Canada Air Lines continued to mature as an instrument of national development while devoting its energies to the immediate requirements of a wartime economy. The period was one of intensive planning for a time when the air line will not only multiply its domestic services but also, as the sole Canadian agency designated by the Government to operate international air services, extend its operations beyond the nation's frontiers." Traffic was close to capacity in 1944 and there was a notable expansion in the trans-Atlantic service. Flights in the Maritimes were rerouted to bring main-line operations closer to Fredericton and Saint John, through Blissville, and direct service was provided between Halifax and Sydney. The new buildings at Winnipeg were occupied; the floor space of the Moncton hangar was doubled.

Early in 1945, Trans-Canada completed a third daily transcontinental flight by extending an existing Montreal-Winnipeg operation through to Vancouver. With the inauguration of another flight between Vancouver and Lethbridge towards the end of the year, a start was made on the fourth transcontinental. (This went into effect in the spring of 1946.) Schedules on the Lethbridge-Calgary-Edmonton route were doubled, while a fourth daily flight between Montreal and Halifax and a second between Halifax and Sydney began in the summer. The company increased its operational flexibility by flying an alternative Toronto-Winnipeg route through the United States when weather so required. This, as Mr. Symington has pointed out, was the first implementation of the two "Air Freedoms", of innocent passage and non-traffic stops. During the year, more hangar accommodation was acquired at Winnipeg and additional space in the ramp building at La Guardia Airport, New York. Moncton was established as a major maintenance base. Radar experiments began at Winnipeg. The contract with the Department of Munitions and Supply for the overhaul of military equipment was completed; but at Montreal work continued unabated on the maintenance, servicing and conversion of B.O.A.C. Liberators in the North Atlantic return ferry service. There were 780 employees engaged in this work. At the end of 1945, T.C.A. payrolls showed a total staff of 3,272, nearly ten times as many as were employed at the end of 1938.

With the close of the war, there was some reduction in the volume of mail carried in 1945 as compared with 1944—an 8 per cent decline; but the number of passengers (limited only by the capacity of the fleet) increased by 17 per cent, and express volume by 11 per cent.

The following table gives an account of the growth of Trans-Canada's traffic in eight years. The air line was in its infancy in 1938, so that comparisons with that year would not be fair; but if we take 1939, the figures are still impressive. In 1945, the number of passengers had increased nearly nine times, the volume of mail nearly seven times and the volume of express more than 20 times.

These figures do not include the trans-Atlantic service, which from its beginning in July, 1943, to the end of 1945 flew 1,785,632

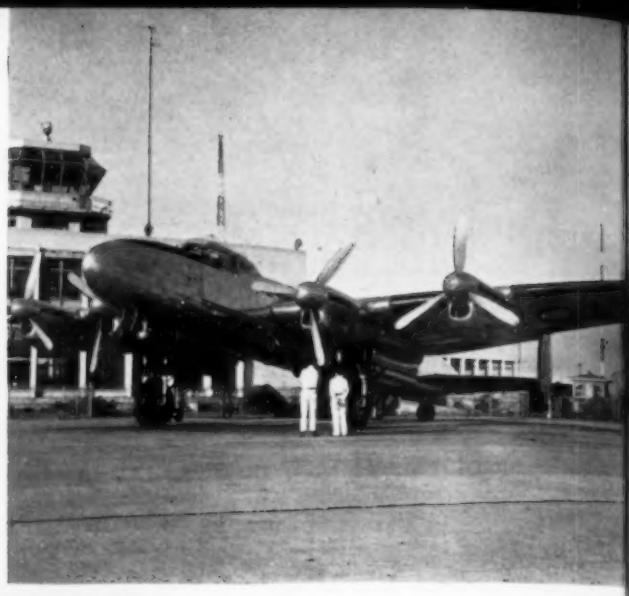
This summer, T.C.A. links Canada with Chicago (upper and lower left) and Cleveland (upper right). It has long been in service between Toronto and New York (lower right).
Chicago views by Aerial Photography Company; New York by *Wide World*

	Passengers	Air Mail (in pounds)	Air Express (in pounds)	Revenue Miles Flown
1938	2,086	367,734	7,806	1,122,179
1939	21,569	523,906	45,819	2,760,090
1940	53,180	927,037	105,788	4,770,219
1941	85,154	1,389,614	173,192	6,384,651
1942	104,446	2,308,812	362,837	7,172,130
1943	140,276	3,726,607	821,606	8,254,819
1944	156,884	3,739,105	856,016	9,110,474
1945	183,121	3,429,232	950,323	10,506,075
Total	746,716	16,412,047	3,323,387	50,080,930

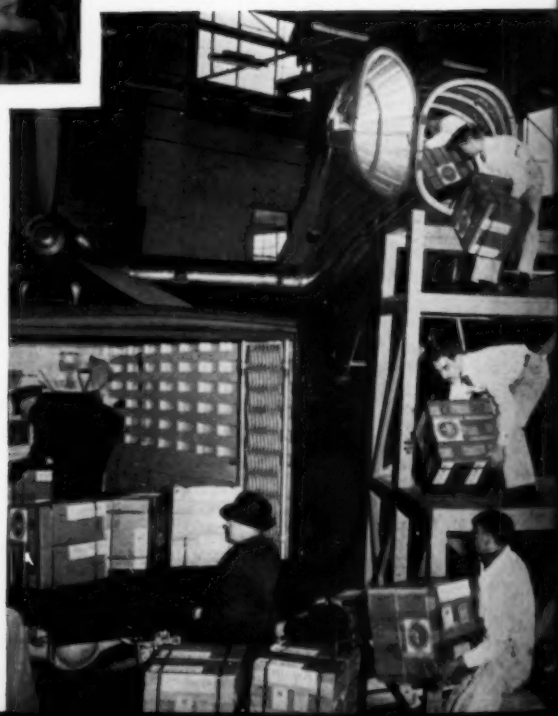
miles, carrying 1,784 passengers, 1,997,005 pounds of mail and 400,306 pounds of cargo.

Trans-Canada Air Line's association with trans-Atlantic flying began in its own inaugural year, 1937, with the first North Atlantic trial flights made by Imperial Airways, now British Overseas Airways Corporation. T.C.A. handled the Canadian arrangements.

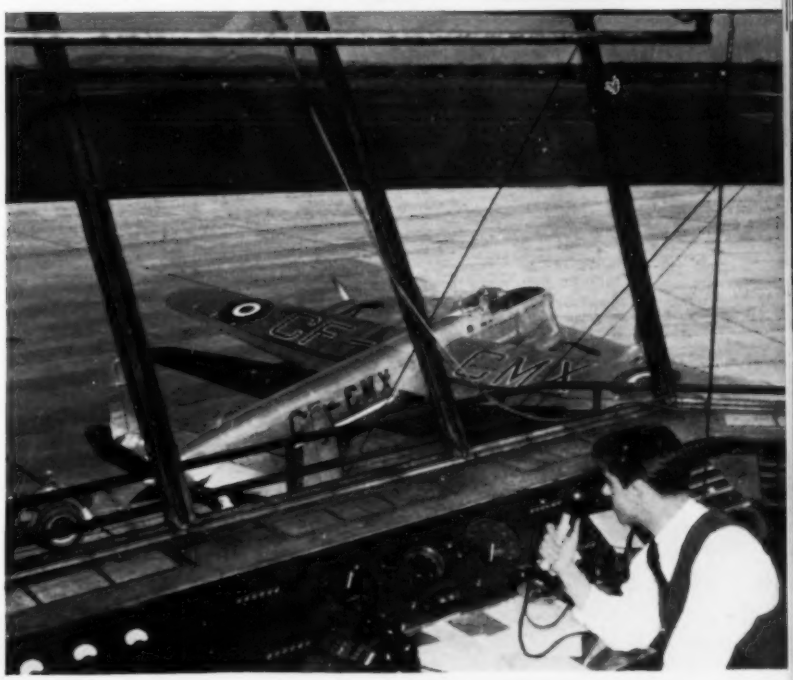
The Canadian service was intended by the Government to speed mails to and from the Canadian forces overseas, as well as parts and equipment, medical supplies and other express shipments of importance to the war effort. At first, no fare-paying passengers were carried, but official passengers, designated by the Department of Transport or the office of the Canadian High Commis-

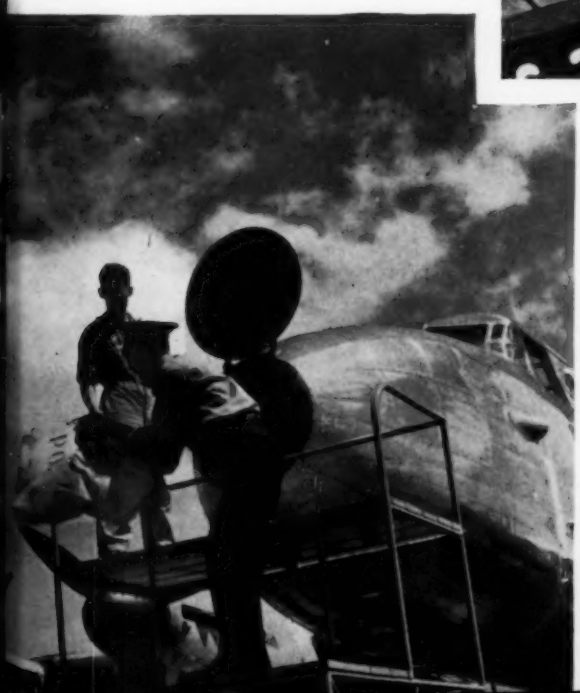


The Atlantic is requently referred to facetiou as "the pond"—and aviation has given this phr some meaning. In little more than half a day may now fly from Montreal to London. The C adian Government trans-Atlantic air service, op ated by Trans-Canada Air Lines, provides f flights weekly across the ocean in each directi The six Canadian-built Lancasters in the serv all have accommodation for ten passengers a can carry nearly 4,000 pounds of mail and press. (Precious penicillin for the relief of suffer Europe is frequently packed into the cargo co partments.) T.C.A. passenger agents, forme R.C.A.F. men, took a special course to fit th for their duties as purser-stewards on the tra Atlantic run.



Top, left to right:—A "Lanc" takes off across the Atlantic; at 86, Mrs. Allena Reid, flying home to Edinburgh, is T.C.A.'s oldest trans-Atlantic passenger. Centre:—One of the Lancasters seen from the tower at Montreal Airport. Bottom, left to right:—Into the nose goes mail for overseas; the passengers settle down with the latest issue of the Canadian Geographical Journal.





Air navigation has the benefit of 24-hour-a-day meteorological service provided by the Department of Transport. Before every scheduled take-off the T.C.A. captain formulates a flight plan based on data gathered from observation and forecasting stations dotted all over the country. Teletype keeps this information up to the minute, and when the aircraft is aloft the crew is supplied with weather news over the radio. These photographs show the preparation of maps and the study of winds by means of balloon and theodolite.

sioner in Great Britain, representatives of the military services and of government departments, technicians and others travelling on urgent war business, were sometimes transported. Towards the close of 1945, with the war over, the policy was changed and the service began developing into a regular air line operation. Passenger tickets were being sold in conformity with prevailing rates; a ticket office had been opened in London; T.C.A. purser-stewards were catering to passenger comfort; and an air express service had been inaugurated. The first all-express flight left Montreal at the end of March, 1946.

The first eastbound flight took place on July 22, 1943, and the first westbound two days later. The route is between Montreal and Prestwick, Scotland, a distance of 3,100 statute miles. A stop is usually made in Newfoundland, but direct flights have frequently been made and T.C.A. holds the trans-Atlantic records, both east and west, between Montreal and Britain. On the first eastbound flight the crossing was made in 12 hours and 26 minutes. While the time was reduced on several occasions before January, 1944, it was then that a new record was made in dramatic fashion: two of the aircraft left Montreal four minutes apart and landed in Prestwick within two minutes of each other. One plane, carrying 6,207 pounds of mail and 119 pounds of express, made the trip in 11 hours and 16 minutes. Coming in two minutes later, the second aircraft, with 4,524 pounds of mail and 408 pounds of express, was clocked at 11 hours and 14 minutes. However, a drastic reduction in time was made the following November, and the record of 10 hours and 15 minutes set then has never been bettered. The fastest westbound crossing, made in November, 1944, is 11 hours and 26 minutes.

The fleet consists of six Canadian-built Lancasters, four-engine planes with accommodation for a crew of five and ten passengers. To meet North Atlantic conditions, they can fly, if necessary, at 26,000 feet and can go higher under stress of weather, but normally they fly at 10,000 feet. They are fitted with radar to ensure safety in navigation. The engines are British Merlins (T-24-4) of 1,650 horsepower each. In the nose compartment of each plane 2,500

pounds of mail and express may be carried, with an additional 1,200 pounds in another compartment. Thermostat-controlled heaters keep the passenger cabins comfortable irrespective of outside temperature; ample provision is made for the storage of food and T.C.A. engineers have designed a new electric system to facilitate the serving of hot meals.

Each Lancaster has a crew of five—captain, first officer, navigator, radio officer and purser-steward. The pilots are all senior men drawn from the T.C.A. transcontinental service and specially trained over the Atlantic. Most of the others were in the R.C.A.F. during the war. Seven T.C.A. passenger agents, all R.C.A.F. veterans, took a special course to fit them for the new duties as purser-stewards.

With the delivery of the 40-passenger aircraft now being built, the Atlantic service will grow in size and importance, and in due course Trans-Canada Air Lines will spread out into the world in other directions. Scheduled services are projected to the West Indies and South America and also across the Pacific.

Great expansion is due soon at home in Canada and across the United States Border. The transcontinental line will be shortened when T.C.A. planes begin flying a more direct route between Toronto and Winnipeg by way of Sault Ste. Marie and the Lakehead. There will be a direct line from Winnipeg to Edmonton through Saskatoon and another from Edmonton to Vancouver. There will also be an operation along the lower St. Lawrence. International services projected are between Halifax and Boston; between Toronto and Chicago; between Toronto and Cleveland; between Port Arthur and Duluth; and between Victoria and Seattle. Some of these are awaiting completion of airway and airport facilities; some will definitely be established this year. Toronto and Chicago will be linked by four daily flights beginning in July. Later in the season, Toronto and Cleveland will be served by three daily flights, and the Victoria-Seattle service will follow.

Trans-Canada Air Lines undertakes its current operations with vigour and enthusiasm, but is also working, building and planning for Canada's part in the aviation world of to-morrow. At the British Commonwealth Conference in Montreal and at the World Conference in Chicago in 1944, the company participated directly within the framework of the Canadian delegations. Its President, Mr. Symington, who was elected first President of the International Air Transport Association, took a prominent part in the discussions, and T.C.A. is represented in all the deliberations of the I.A.T.A. and P.I.C.A.O.

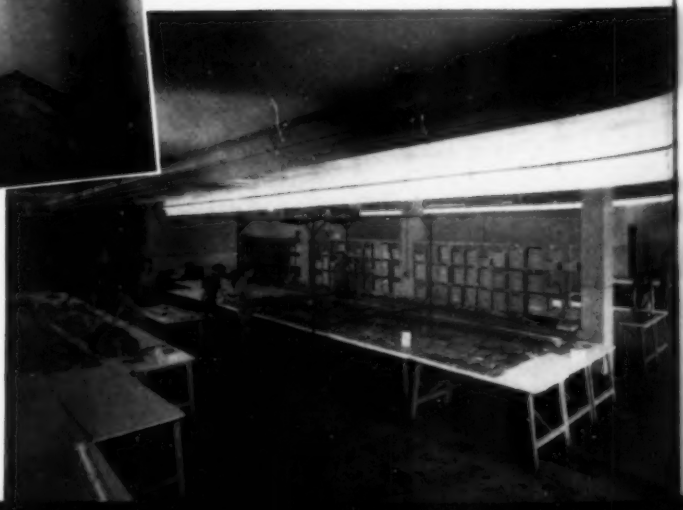
Canada is not only air-minded—she is world-air-minded. It was by no means an accident that the Dominion was chosen as headquarters for the International Civil Aviation Association. "We feel that the honour is merited by geography", said Hon. C. D. Howe, the Minister charged with the development of civil aviation in Canada, when he welcomed the delegates to the provisional organization meeting in Montreal in August, 1944. "Our geographical position is such that it is inevitable that Canada occupy an important place among the nations of the world. The short international routes between the centres of population of the Northern Hemisphere, almost without exception, pass over Canadian territory. Placed as we are between Europe and Asia, we are strategically situated in respect to the world's airways, and, as the emergencies of the war recede, the Dominion, and the headquarters of the Council will be readily accessible by air from all parts of the world."

Canada not only realizes her position in the air world but she is fully aware of her responsibilities. The Prime Minister said in the House of Commons several years ago: "The Canadian Government strongly favours a policy of international collaboration and co-operation in air transport and is prepared to support in international negotiations whatever international air transport policy can be demonstrated as being best calculated to serve not only the immediate national interests of Canada but also our ever-rising interest in the establishment of an international order which will prevent the outbreak of another war."

Canadians may be confident that Trans-Canada Air Lines will represent the Dominion with distinction in international air circles.

Top:—Mitchell aircraft of the R.C.A.F. Photographic Wing, with three cameras mounted in the nose, from which large areas are photographed from 20,000 feet.

Left:—Rolls of film, each in a light-proof container, received from the field at the Photographic Establishment laboratories, R.C.A.F. Station, Rockcliffe.



Right:—Tables on which photographs are laid out to form a mosaic. Sections of these are then photographed for indexing purposes.

Air Photographs Speed Reconstruction

by J. FERGUS GRANT

(Photographs by the R.C.A.F.)

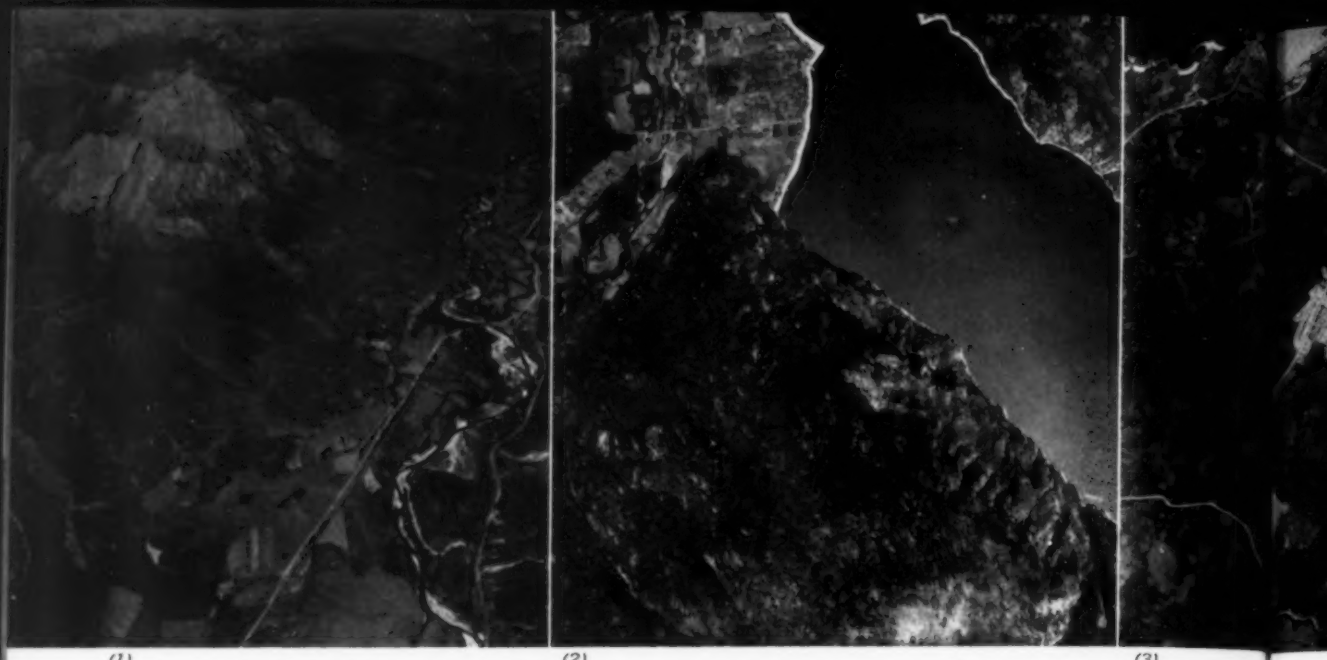
AERIAL PHOTOGRAPHY is an important factor in the present programme of reconstruction, reconversion and rehabilitation, which is receiving the full consideration of government agencies, commerce and industry. The success of plans for the efficient development of Canada's natural resources depends to a large extent on the rapidity with which various projects can be initiated. It is essential, therefore, that those facilities which aircraft make available be fully utilized to secure basic information concerning physical features of the country.

Thirty years have elapsed since aerial photography was first applied to the production of maps, when in 1916 an air survey of Flanders and Picardy provided for the incorporation on existing sheets of fresh detail, such as trenches and other data of military importance. Much progress was achieved after the conclusion of hostilities, especially in Canada with its vast unexplored area. The Royal Canadian Air Force, which was created in April, 1924, contributed in no small degree to this advance. Had not an efficient photographic organization been established, and material assistance rendered to various government agencies in the development and protection of this country's natural resources, the demand for economy in the early "thirties" might well have witnessed the disappearance of this struggling organization. Fortunately, a force of some four thousand personnel existed to furnish the nucleus around which the British Commonwealth Air Training Plan was evolved in 1939.

Six years of war witnessed a striking change in the character of cameras and the employment of aerial survey technique. Much credit is due to those engaged in research in Great Britain, particularly in the perfection and production of lenses; nevertheless, the material contributions made by the R.C.A.F., through its photographic establishment at Rockcliffe, and by the National Research Council in Ottawa, cannot be overlooked. Personnel, equipment and scientific data may now be redirected from warfare to peacetime developments.

Although an Interdepartmental Committee on Air Surveys was established in 1933 to receive and co-ordinate requests for air photography from Federal Government departments, the magnitude of its functions was only appreciated to the full as the clouds of conflict began to lift. The outbreak of hostilities in 1939 halted for nearly five years any material progress in the photographic programme, so far as this might contribute towards the national economy. Many thousands of square miles were photographed in 1944, and maps of specific areas were prepared to meet ever-increasing requirements.

But, it was only in 1945 that the committee was enabled to execute a comprehensive programme. Hostilities were drawing to a close, thereby enabling facilities of the R.C.A.F. "photographic wing" to be made available for tasks that would expedite reconstruction, reconversion and rehabilitation measures. Territory amounting to 186,868 square miles was covered during the past year with a vertical mesh, being photographed with modern cartographic cameras. Sixteen aircraft were assigned to specific areas, extending from Nova Scotia to British Columbia and north to the Arctic Circle. In addition, the R.C.A.F. recorded the topographical features of some 75,000 square miles of territory by tri-camera photography,



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Considerable topographical data is furnished by these photographs, together with details for hydro[illegible]ys and from which the forested slope rises 3,000 feet to an altitude of 6,900 feet in the Valkyre Mount[illegible] of pi farmland and woodlots in Prince Edward Island (5) Heatherton, N.S., showing r[illegible]ays, r

used principally in the preparation of air navigation charts. Had it not been for reduced visibility, occasioned by the smoke from muskeg fires over a wide area, some 300,000 square miles would have been covered.

Programme this Year

Although the ultimate government policy concerning aerial photography has not been determined, the programme prepared by the Interdepartmental Committee on Air Surveys for 1946 provides for approximately 200,000 square miles of vertical photography. Priorities have been established, taking operational factors and meteorological probabilities into consideration, and the areas are now being photographed by the various detachments charged with this responsibility.

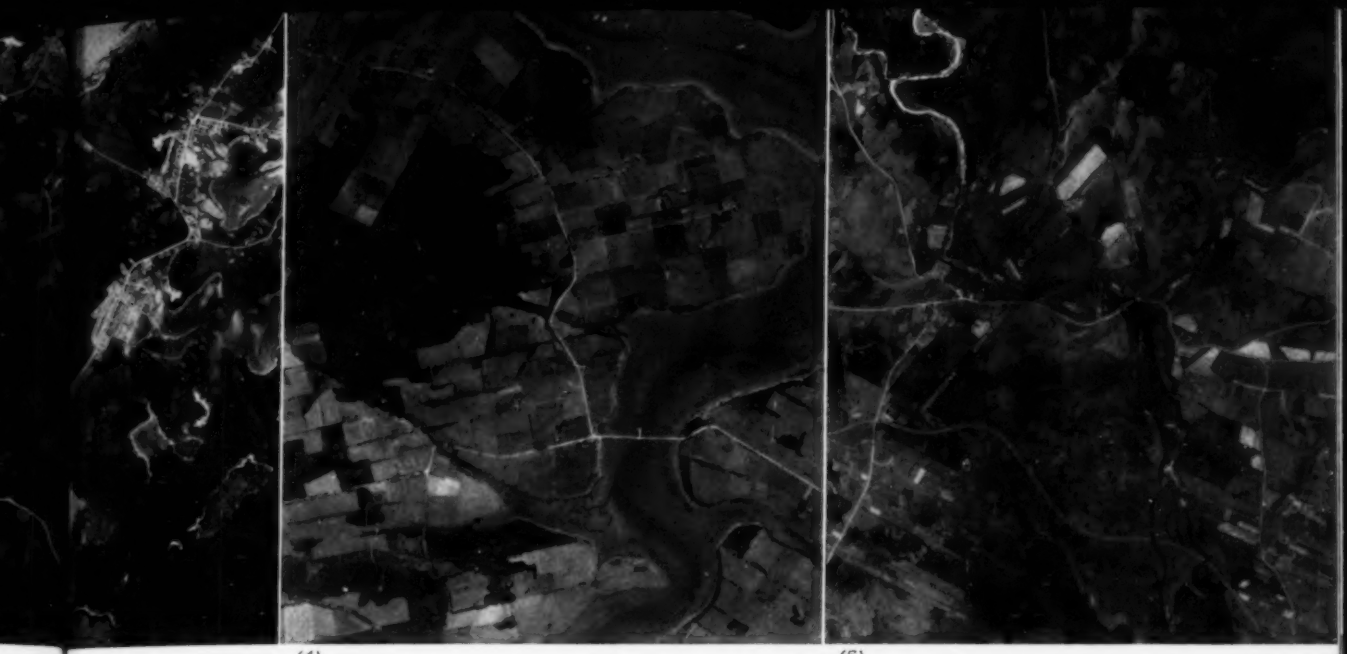
In addition to the programme prepared by this committee, the R.C.A.F. is required to undertake during the current year some 300,000 square miles of tri-camera photography, performed with larger aircraft having a greater range of operation. As it is proposed to photograph the entire mainland of Canada, south of the Arctic Islands (an area of 3,695,189 square miles), the R.C.A.F. has been charged with the responsibility of covering roughly three hundred thousand square miles a year, depending on its available resources of personnel and equipment, and upon weather conditions.

It may readily be appreciated that the provision and maintenance of an efficient photographic establishment is in the national interest. Scientific advances made over a period of some twenty years enabled Canada to contribute a wealth of experience to the perfecting of aerial reconnaissance during the early stages of World War II. Aerial photography will be retained as an essential phase of training in the R.C.A.F., which enjoys the advantage of access to results of extensive research undertaken by the Royal Air Force.

Developments in the use of radar will contribute materially to the application of aerial photography. Although radar control may be installed in some aircraft in 1946, it is unlikely that this equipment will be used to any large extent until next year. In 1945, it was necessary to employ four aircraft to transport personnel and equipment for the establishment of seventy-five astronomical fixation points; however, the introduction of radar will greatly reduce such operations, each photograph being its own control station.

Demand for Photographs

It is now claimed that, with the war ended, there is a great quantity of photographic



(4) (5)

hydro…s and a forest inventory (1) Elk River, near Fernie, British Columbia (2) Lower Arrow Lake, B.C., Mount… of picture and clearly revealed by a stereoscope (3) Black's Harbour, Nova Scotia (4) Typical …wing r…ays, rivers, agricultural areas and farmsteads, with wooded areas clearly defined.

equipment available for the use of aircrew with some experience of aerial photography. But this was designed primarily for reconnaissance purposes. Until such time as suitable cartographic cameras can be manufactured and modern laboratory equipment furnished, the provision of accurate maps of this country is held to be the responsibility of the Federal Government. Furthermore, so urgent are the demands from various departments for air photographs of high quality, that only those organizations with experienced personnel and modern facilities can be charged with any of these priority tasks and awarded contracts.

Mention should be made, however, of the Canadian Pacific Air Lines, whose survey division was originally an important branch of Canadian Airways, Limited. During the past year, it assisted materially in meeting federal requirements, to the extent of 1,895 square miles, with control lines. Commercial contracts were also undertaken, including the provision of large-scale mosaics for mining interests, and one of Glace Bay, Nova Scotia, a railway survey in Labrador, an oil survey in the foothills of the Rocky Mountains, and strip maps for power companies. But any large scale operations involving heavy capital outlays must necessarily be carried out, at this time, by an organization with even larger laboratory facilities, such as those of the R.C.A.F. at Rockcliffe.

Six years of war have drawn heavily on the natural resources of Canada and made essential a material increase in agricultural production; it is necessary, therefore, that efforts be directed to their further development through exploration. There is considerable scope for private enterprise, but this must be integrated with a broad national programme of research and conservation to secure for all sections of the Dominion the maximum economic advantages. Some indication of the extensive manner in which air photographs can be used effectively is revealed in the public investment policy outlined by the Federal Government at the Dominion-Provincial Conference on Reconstruction. This involves a wide variety of surveys, for which basic information can be most readily furnished by aerial photography. Briefly, air photographs are required for:

(a) Preparation of air navigation charts, used for planning, pilotage and plotting purposes.

(b) Preparation of maps of a military character, required for the defence of this country, the training of the Canadian Army and for combined operations.

(c) Preparation of hydrographic charts of Canada's coastal and inland waters.

(d) Preparation of topographical maps, which furnish an essential foundation for any survey of natural resources.

(e) Preparation of geological maps, used extensively in the development of the mining industry.

(f) Preparation of a national forest inventory, to aid in the management and protection of timber territory from destruction by fire and the ravages of insects, and the evolution of silvicultural practices.

(g) Surveys involving the protection of regional watersheds, the development of river systems, irrigation of dry areas and the prevention of floods.

(h) Research involving the classification of land and vegetation, the reclamation of marsh lands, control of soil erosion and soil surveys.

(i) Surveys involving the provision of hydro-power. These frequently embrace irrigation projects, flood control, land reclamation and even navigation.

(j) Surveys involving the protection of migratory and other wild life, the conservation of the fur industry, and the preservation of reindeer and wood buffalo herds.

(k) Regional, town and community planning surveys.

(l) Transportation surveys, including the location and development of airports, the location of railways and highways, with international connections and approaches to national parks or communities whose expansion necessitates the construction of new roads.

(m) Surveys to assist in development of the tourist industry, directing attention to forests, lakes and streams, portages and trails, desirable sites for camps and lodges, potential ski runs, etc.

Air photographs have been undertaken to assist in other special surveys, as well; for example, in New Brunswick they have been used to determine suitable areas for the commercial cultivation of blueberries, and to establish the location of oyster leases.

Operational Details

Numerous operational details receive careful consideration at Air Force Headquarters and in the Photographic Wing well in advance of the departure of aircraft and their crews for the field, especially as fullest advantage must be taken of the relatively short season during which film may effectively be exposed. Although priorities are set by the Interdepartmental Committee on Air Surveys, these are necessarily governed by weather and light conditions. In the Northwest Territories, for example, operations are restricted to a period of two months, from the beginning of July to the end of August.

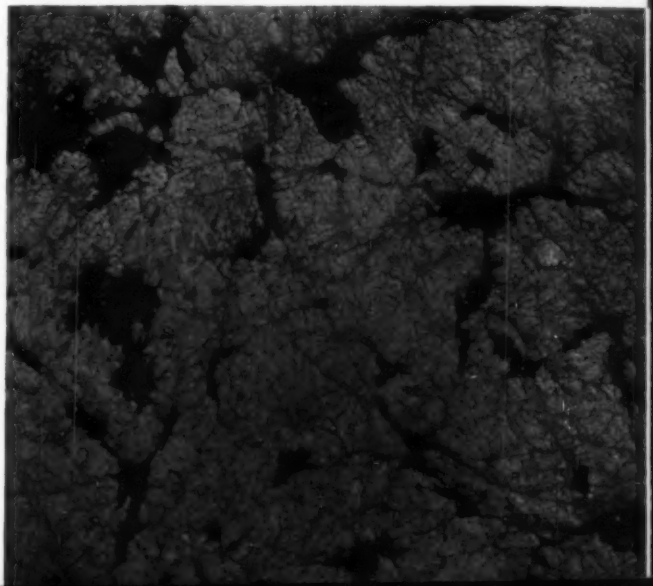
During the past year, sixteen Anson aircraft, in five detachments, were employed on

Photographs at left portray the townsite of Yellowknife, seen at the neck of peninsula projecting into Great Slave Lake, with the roadway to adjacent airport. These were exposed on the same flight line, and indicate considerable overlap, as required in the preparation of a mosaic.

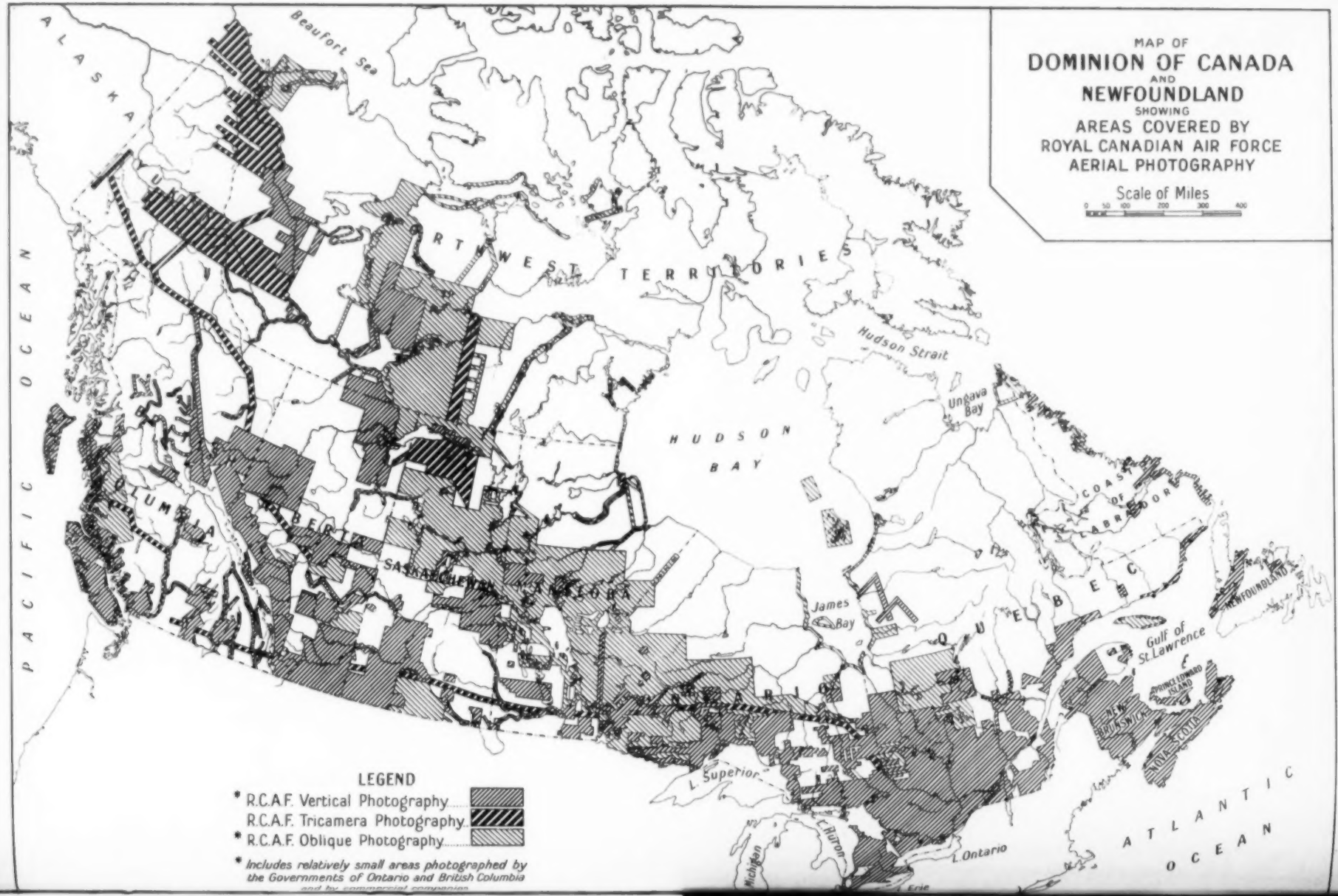
vertical photography. One detachment of three Mitchell long-range aircraft was engaged on tri-camera photography, and a fourth in photographing the Columbia River Valley. One Canso amphibian furnished transportation, both for the transfer of detachment personnel with their camp equipment and for the movement of supplies of all kinds from railhead to the base of operations. Another Canso amphibian was employed as "mother ship" for three Norsemen aircraft on floats, engaged along the western shores of Hudson Bay in establishing ground control for the aerial survey of a very large area north of Churchill, through which personnel of "Exercise Musk-Ox" drove their snowmobiles last winter.

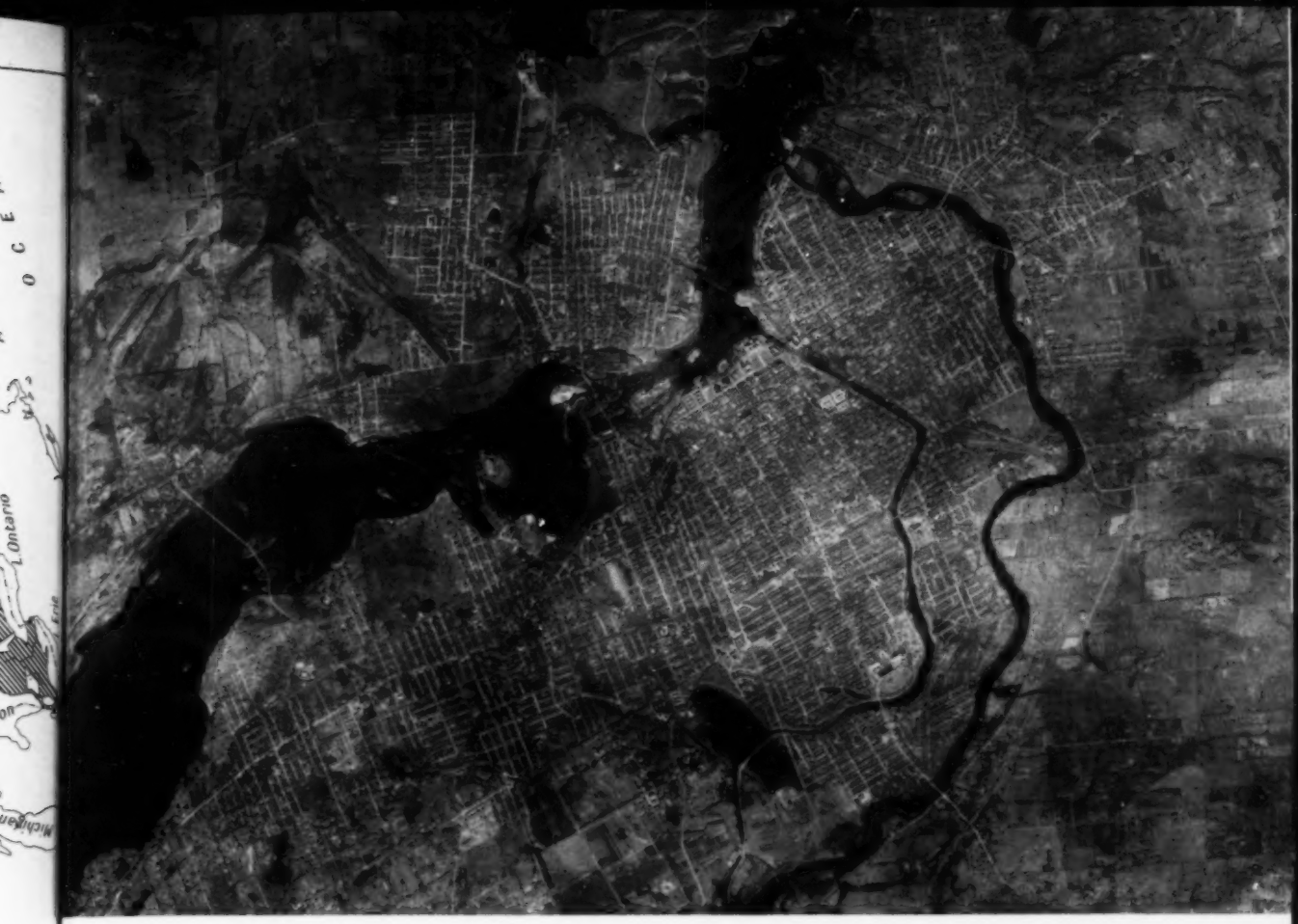
A Mitchell detachment consists of some thirty personnel, including the pilot, co-pilot, navigator, camera operator, wireless operator, wireless mechanic, electrical mechanic, instrument mechanic, aero-engine mechanics, airframe mechanics, chef and general duties airmen. The Canso crew, consisting of six personnel, has a wide variety of duties, which even include the purchase of fresh vegetables, fruit and meat, the sorting of supplies for the detachments, and loading operations.

The Canso "mother ship" is also responsible for carrying supplies to weather stations at Brochet Lake, Nueltin Lake and Kazan River, in Northern Manitoba and the Northwest Territories. Personnel, consisting of one wireless operator and a meteorological observer at each unit, furnish information to Churchill, on Hudson Bay, whence it is relayed to a weather forecaster at Fort Smith on the Slave River. This, with additional data secured from observers in the Northwest, enables him to furnish meteorological information to the various detachments in sufficient time for them to plan their day's flights.



Typical terrain to the northwest of Yellowknife, indicating the absence of overburden and the scarred rock of the Canadian Shield, caused by the spread of a continental ice mass in pleistocene times. Gold occurrences are widespread in this region. Air photographs, such as this, assist in the preparation of maps, essential for detailed mineral exploration over large areas. They reveal rectilinear features, or "lineaments", and major geological faults. They may also assist in the location of mining claims.


MAP OF
DOMINION OF CANADA
AND
NEWFOUNDLAND
SHOWING
AREAS COVERED BY
ROYAL CANADIAN AIR FORCE
AERIAL PHOTOGRAPHY
Scale of Miles
0 50 100 200 300 400
ALASKA
Beaufort Sea
PACIFIC OCEAN
NORTHWEST TERRITORIES
Hudson Strait
Ungava Bay
HUDSON BAY
COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
James Bay
QUEBEC
COAST OF LABRADOR
NEWFOUNDLAND
Gulf of St. Lawrence
PRINCE EDWARD ISLAND
NEW BRUNSWICK
NOVA SCOTIA
L. Superior
Michigan
L. Huron
L. Ontario
Erie
ATLANTIC OCEAN
LEGEND
* R.C.A.F. Vertical Photography
R.C.A.F. Tricamera Photography
* R.C.A.F. Oblique Photography
* Includes relatively small areas photographed by the Governments of Ontario and British Columbia and by commercial companies



Mosaic of Ottawa, Ontario, and Hull, Quebec, recently prepared to assist in planning Canada's federal capital. The Ottawa and Rideau Rivers and the Rideau Canal are clearly shown in this series of some 500 overlapping photographs.

Gasoline and oil are shipped, where possible, by rail and water, though advantage is taken of the Alaska Highway to fill requirements of aircraft operating from bases between Edmonton and Whitehorse. During the past year, aircraft of the Anson detachments were flown 3,936 hours, during which they consumed 117,442 gallons of gasoline and 996 gallons of oil.

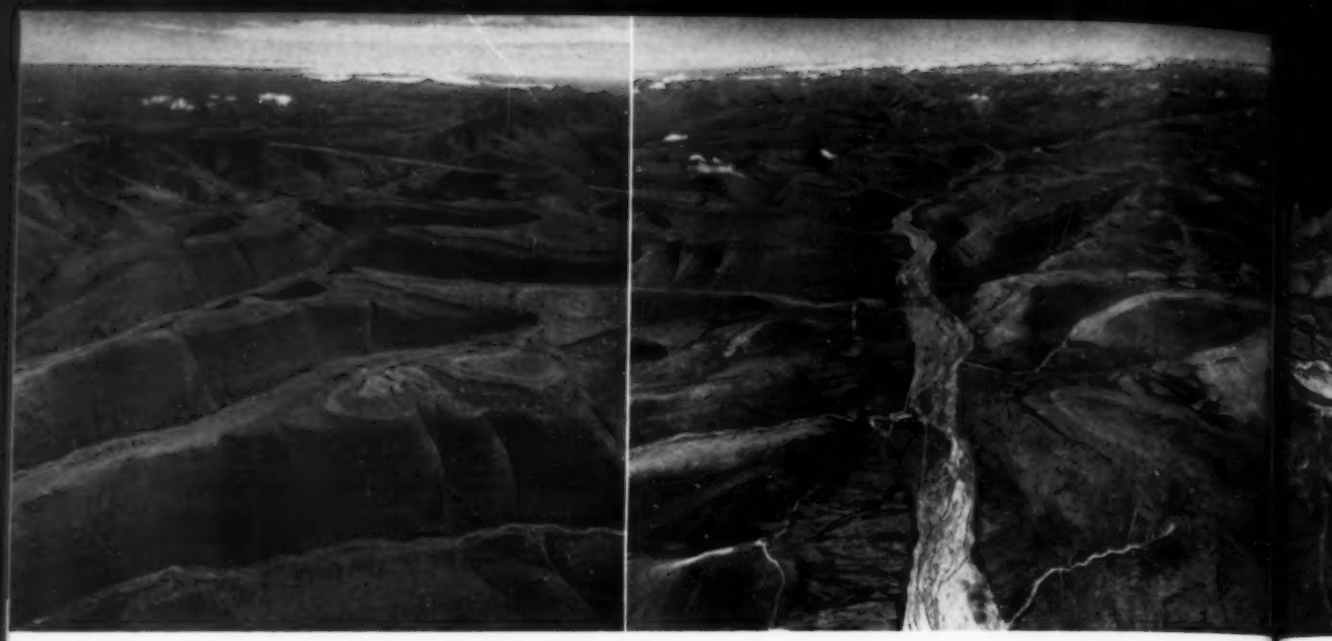
Film, which is stored in refrigerated vaults at Rockcliffe, is shipped by express to the rail centre closest to the base of operations as required, and thence flown in to the detachments. It is possible to eliminate deterioration thereby, and to keep the film relatively cool and dry. When exposed, the film is flown out and shipped by express to the laboratory at Rockcliffe, where it passes through a continuous processing machine that is thermostatically controlled. Although developed by the R.A.F. in England, this particular machine was perfected in Canada. During the past year, a total of 2,036 rolls of film, at a cost of some $71,000, was used in photographing 186,868 square miles of territory. A complete record of all factors pertaining to the use of film is maintained and referred to the manufacturer with a view to effecting further improvements.

Another operational problem involves the supply of oxygen which is used by aircrew when flying above 10,000 feet. As vertical photographs are taken at between 10,000 and 12,000 feet, and tri-camera photographs at 20,000 feet, it is necessary to use oxygen almost continuously. A total of 1,831 bottles, shipped from either Montreal or Vancouver, was required during the past season for personnel of the Anson detachments.

Air Navigation Charts Issued

While the British Commonwealth Air Training Plan has been described as this

* Includes relatively small areas photographed by the Governments of Ontario and British Columbia and the commercial companies.



country's greatest contribution to the war effort, the monumental task of furnishing air navigation charts and the contribution thereto of aerial photography has seldom been appreciated. Only six charts, on a scale of eight miles to an inch, were available at the outbreak of war in 1939, though others along the Trans-Canada Airway were in course of preparation.

One of the immediate requirements was coverage of the Gulf of St. Lawrence and Canada's eastern seaboard, which was provided in less than a week. Areas adjacent to flying training schools were given top priority, and within sixteen months of the commencement of hostilities a total of thirty-nine charts had been completed. At the present time, seventy-two standard sheets, printed in full colour with elevation tints, are available. An additional 149 preliminary editions have been produced in from two to four colours. The total coverage of these pilotage charts is approximately 5,250,000 square miles, including Newfoundland, the coast of Labrador and extensions into United States territory. Charts on a scale of 15.78 miles to an inch are now in demand to meet the requirements of increased speed in air transportation. This scale has been adopted as standard by the Provisional International Civil Aviation Organization.

Distribution of maps increased beyond all expectations. During the twelve months prior to the war, the Legal Survey and Map Service, Department of Mines and Resources, distributed 137,720 sheets. By the end of the fifth year of the war, distribution had increased to 1,850,000. Printing facilities of the Geographical Section of the General Staff, Department of National Defence, implemented those of the Department of Mines and Resources.

Following the outbreak of war against Japan, the United States, by photographic coverage of considerable territory in the northern part of Canada, provided invaluable assistance. New air routes were established through the northern latitudes, some to assist in the development of engineering projects, others for defence purposes and for ferrying aircraft. Meteorological stations and radio location units were built in isolated areas, including the Arctic Islands. It was therefore decided to produce the Canadian Air Navigation Series for the entire Dominion. Much additional data is required; as obtained, this is incorporated in the revised charts which are issued at periodic intervals.

The Dominion Government is responsible for the Yukon, Northwest Territories, National Parks and other Crown lands. There are twenty-five hundred Indian Reserves, of which the legal boundaries must be established, and in which the sub-division of land for trapping and agriculture, and development of roads and trails is necessary

Left:—Mackenzie Mountains, over and through which the "Canol" pipeline was laid from Norman Wells to Whitehorse in the Yukon, a distance of some 600 miles. The right-of-way climbs from an elevation of 300 feet above sea level at the Mackenzie River to an altitude of 5,840 feet on the "Plains of Abraham", a bleak plateau, within the first 90 miles. (The pipeline may be seen in the centre and right photographs as a faint white line.)

Right:—Delta of the Mackenzie River, one of the best muskrat areas in Canada. From such photographs are also prepared maps to assist herders in directing the spring and autumn migration of reindeer, which seek the Arctic Coast in summer to escape insect pests.

Left:—Shrubby alluvial flats and marshes of Wood Buffalo Park, between Lake Claire and Lake Athabaska, Northern Alberta. This section of the continent's largest game preserve produces between 70,000 and 90,000 muskrat skins a year, besides those of skunks and other fur-bearing animals. Conservation measures involve the stabilization of water levels by the construction of dams.

Left:—Airport at Fort Nelson, Northern British Columbia, the creation of which materially facilitated construction of the Alaska Highway. The main runway parallels the Muskwa River near its junction with the Nelson. (See map of this area on opposite page.)

logically, and that two hundred years would be required to complete the task at the present rate of progress. However, provided base maps on a scale of four and eight inches to a mile can be made available, it is maintained that sixty geologists would be able to cover that section of the country presently unmapped in from twenty to twenty-five years. Although research has not indicated the extent to which radar can reveal ore bodies, it is safe to say that radio-active geological formations can be disclosed by such means.

Inventory of Forest Resources

Canada's forest and associated industries depend largely on adequate management of her natural resources. It is necessary, therefore, that a careful inventory of such wealth be maintained. The productive forest area of this country is estimated to be 700,000

Right:—Bridge over Muskwa River, four miles southwest of Fort Nelson, and a section of the Alaska Highway, which rises steeply after crossing the stream. Earlier photographs assisted in the location of this strategic artery. Forest cover is clearly shown. (This photograph is a vertical extension of the oblique at top of page.)

for the administration. Air photographs enable these legal surveys to be undertaken with a minimum of delay.

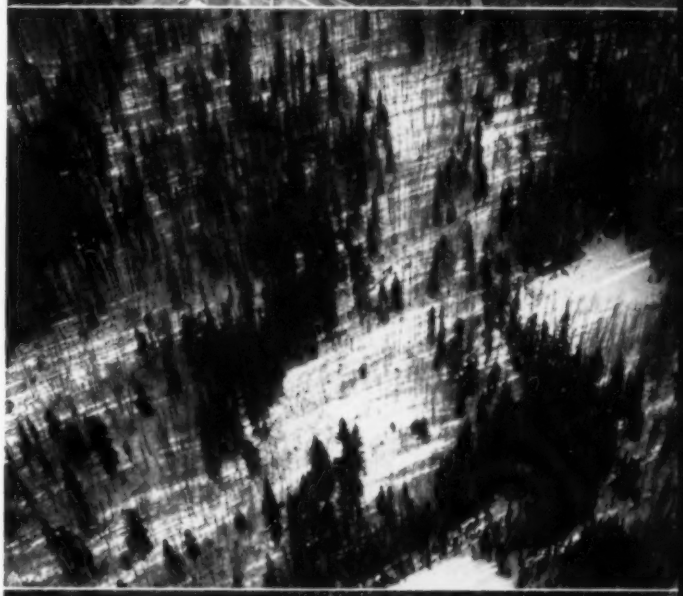
Base maps, prepared by the Topographical Survey Division, Department of Mines and Resources, are essential for the geological development of the country. While considerable information concerning the distribution of rock formations was furnished by the early geologists, much of this was confined to the main water routes, and failed to provide adequate coverage of the wide areas distant from the principal rivers. Now it is possible to apply horizontal and vertical control to air photographs, and so to produce more accurate maps with greater rapidity.

It is estimated that only eleven per cent of Canada has been adequately mapped geo-

square miles. Natural and artificial reproduction, logging operations, destruction by fire, disease and insect infestation, programmes involving the conservation of moisture and alterations in watersheds, and classsification requirements necessitate the preparation of a new inventory every ten years. An area of some 70,000 square miles should be photographed each year to meet this demand.

Forests lend themselves readily to examination from elevations. The aerial camera, therefore, produces a permanent record in convenient form. Unproductive and unmerchantable areas can be eliminated quite readily through the examination of air photographs. Control, furnished by maps prepared from such photographs, also renders unnecessary the preparation of costly forest base lines.

In order to determine the size of timber, as shown in oblique photographs, a tree

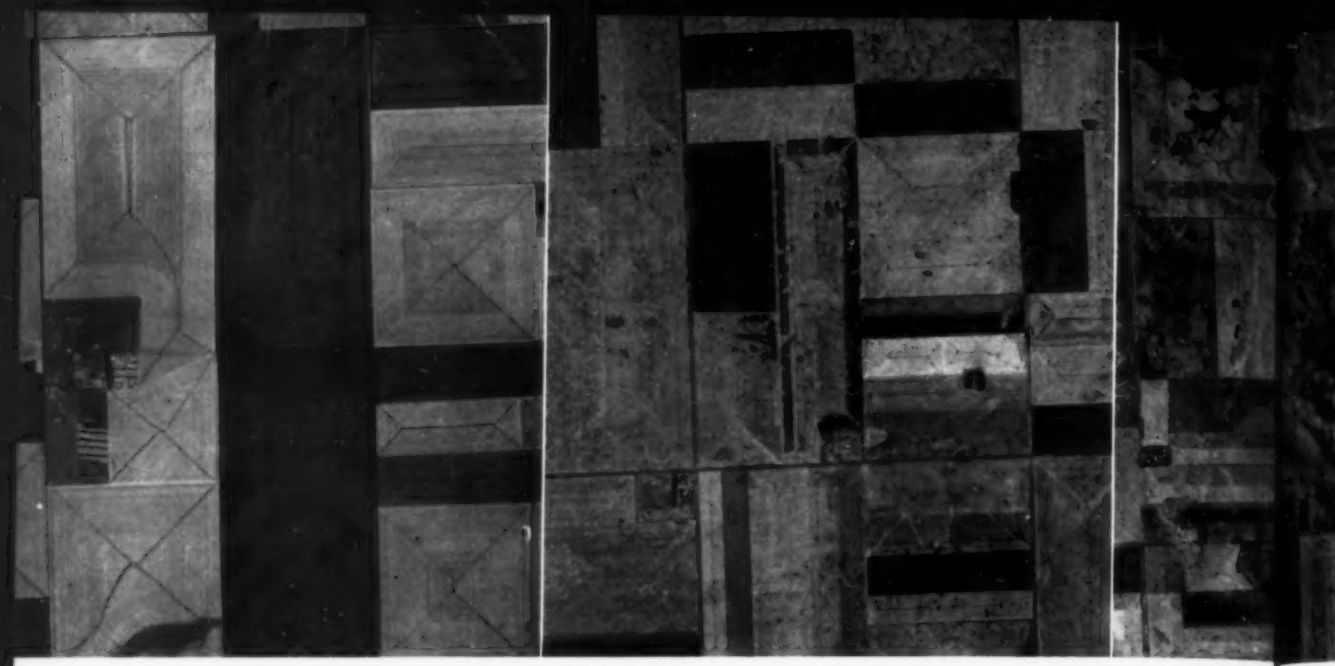


Aerial photography assists in the rapid identification of forest sites and the preparation of a forest inventory.

Top:—Topographical features and forest cover clearly defined.

Centre:—Oblique views simplify measurement.

Bottom:—Tone differentiations, or reflective powers of foliage, aid in identification of timber types.



Air photographs assist in the classification of large agricultural areas. Left to right:—Land Class III, Land Class I, which is sub-marginal prod

height grid was developed by the Dominion Forest Service to gauge the general heights of stands. For verticals, a time shadow curve is plotted from values based on the calculation of the sun's altitude at various hours of the day, and thus the average height of a timber stand may be calculated. It is interesting to note that this grid was used during the war to measure the height of buildings in enemy territory, as shown in reconnaissance photographs.

Winter photography has certain advantages in that, at this time, the evergreens stand out in bold relief. Hardwood types are, however, more easily distinguishable in spring and autumn photographs. Summer photographs, on the other hand, are particularly valuable for logging surveys, since they indicate clearly the size of hardwood crowns, thus facilitating age classifications. From air photographs, too, the area of a watershed can be estimated, and the drivability of streams established.

Configuration of the land surface may be determined by means of the stereoscope, and contour lines drawn. This and all the related data which is secured from aerial photographs is of inestimable value in logging operations.

Importance to Agriculture

Agriculture, including stock raising and horticulture, is the most important single industry in this country, employing more than one-quarter of the total gainfully occupied population. While the peak of wartime production was reached at the close of 1944, it is becoming ever more evident that world conditions have issued a greater challenge to the Canadian farmer. Millions of people in Europe and Asia are facing the spectre of starvation, which can be eliminated only by those nations in a position to create a large exportable surplus of foodstuffs. It is essential that every effort should be exerted by Canada to increase produc-

Areas of arable land and woodlots are readily outlined. Protective screen of trees around farmstead at left centre of photograph, taken at 10,000 feet, may be noted.

d Class III, which are suitable for wheat production; Land Class II, marginal for wheat production; and -margi production but suitable for grazing.

tion, intensify the conservation of staple commodities, such as cereals, and evolve measures whereby more territory may be brought under cultivation.

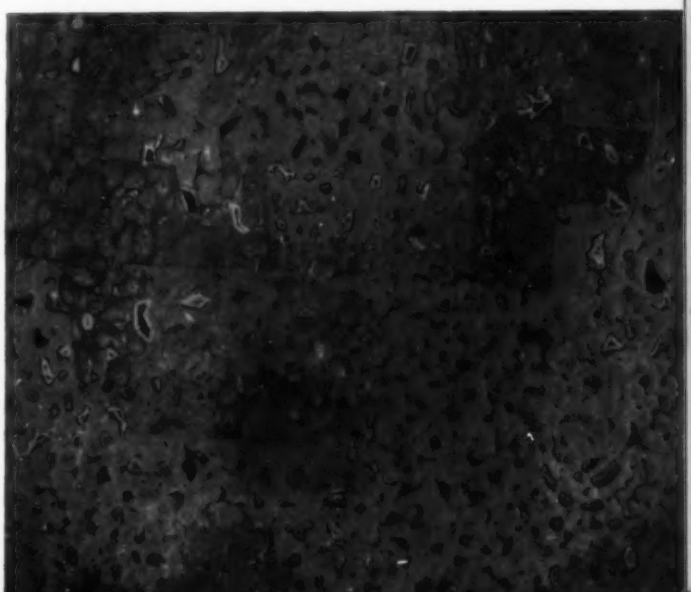
Aerial photography has already contributed materially to the success of economic and soil surveys, but much additional information is required for the development of Canada's agricultural resources. This is being secured largely through the efforts of those charged with direction of the Prairie Farm Rehabilitation programme, which was inaugurated in 1935 to assist farmers in solving many of their problems. Its objectives are:

(a) Cultural—to secure the adoption by farmers of such tillage and cropping practices as will enable them to farm successfully under a wide and fluctuating range of physical and economic hazards.

(b) Land Utilization—to divert crop production from poor land and to use such land for grazing.

(c) Water Development—to make better use of the limited water resources of the Prairies for agriculture than formerly.

Irrigation is of material importance in the Prairie Provinces. Rain in some areas is insufficient to maintain a high water table in the soil, which could be tapped by means of shallow wells. Many streams originating within the prairie region are of an intermittent type, and flow only during the spring thaw or after very heavy rains. Reasonably reliable supplies of water are obtainable from widely separated rivers flowing east from the Rocky Mountains, for the most part in deeply trenched valleys that prevent their utilization for irrigation. Water development, as carried out under the P.F.R.A., consists of large and small projects. The former include storage and irrigation works on the larger rivers, and are intended to serve community needs. The latter consist of dug-

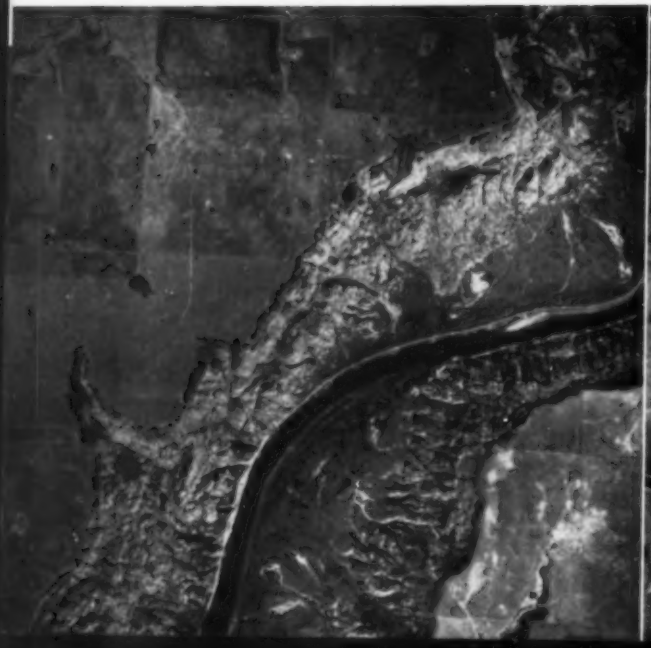


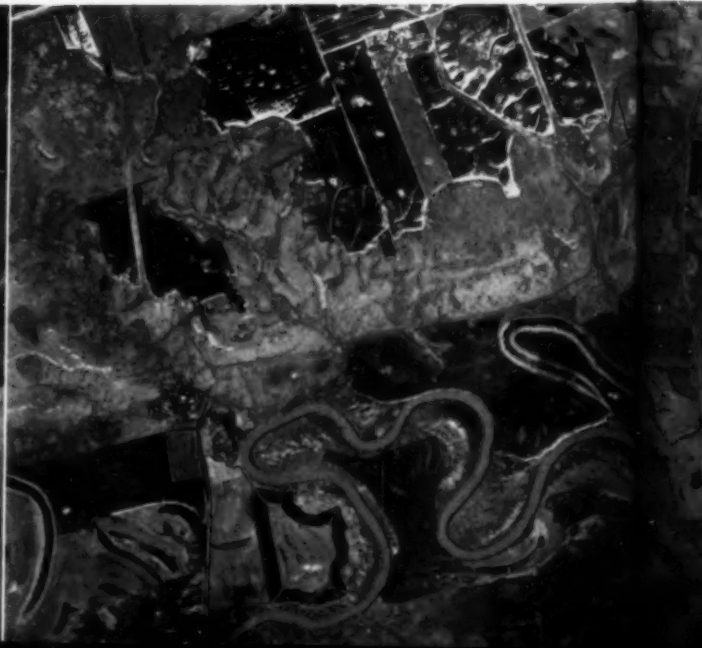
Agricultural survey—poor prairie land, marked by meteorites.

outs, stock-watering dams and irrigation works, developed for the purpose of providing water for individual farms. Between 1935 and 1943, some sixty-four major irrigation projects, involving an expenditure of some $6,000,000, were undertaken. These included the construction of thirty-six dams to provide 365,000 acre-feet of water storage for 110,000 acres of land; the construction of thirty-seven stock-watering dams, having a total storage capacity of some 15,000 acre-feet; the development of three large irrigation systems in Alberta, and the construction of reservoirs. In addition, assistance was rendered to individual farmers by the provision of 14,649 water-storage dugouts, 3,889 stock-watering dams and 935 irrigation projects, involving an expenditure of over $2,000,000.

Aerial photography expedites immeasurably land classification, thus playing a vital role in the land utilization programme. Almost every feature of present land use is portrayed by such photographs, including area of arable lands, topography, excessive

Left:—Wide coverage is provided with three cameras in one aircraft. Top photograph is the left oblique while that below is the vertical of three taken simultaneously on a flight line crossing over Lethbridge, Alberta. Besides their use for topographical surveys, these assist in the classification of land, the provision of irrigation facilities and a study of soil erosion. (Rectangle at bottom is prisoner-of-war camp.)





Regina, Saskatchewan; air photographs are used for town planning, land classification and the determination of assessed values in urban and rural areas.

stoniness, alkali, light textured soils, etc. It is estimated, for example, that almost one-quarter of the settled area of the Prairie Provinces consists of sub-marginal lands, the yield from which would not provide sufficient revenue to meet production costs.

The control of soil drifting, strip farming, land reclamation, the restoration of grass cover, the establishment of community pastures, the utilization of submarginal land for grazing purposes, tree planting and the provision of shelter belts, the improvement of farmsteads, the estimation of crop yields, and the evaluation of land for assessment of taxes or mortgage financing, is by no means

Irrigation projects are planned and drainage maps prepared from air photographs.

Left to right:—Red Deer River, Alberta; Assiniboine River, Manitoba, showing old and new "ox-bow" water courses; irrigation project and water-storage dugouts near Lethbridge.

Hundreds of similar vertical photographs of the Columbia River Valley, British Columbia, enable engineers to determine sites of dams, power plants and irrigation works, forest growth to be cleared from projected flood areas, volume of water storage, and new highway locations; they also form the basis of legal surveys. Seen through a stereoscope, photographs reveal contours clearly.

an exhaustive list of the many fields of agricultural research in which air photography is invaluable.

Hydro-power Projects Planned

Canada's basic geological formations, with their superimposed topographical features, are responsible for a fresh-water area officially estimated at 228,307 square miles, which is larger than that of any other country, and more than double the whole land area of Great Britain and Ireland. As all this area is above sea level, much of it being at a considerable altitude, the flow of water to the sea creates sources of potential energy at every rapid and fall. Hydro-power contributed in no small degree to the tremendous expansion of industry during the recent conflict; and mass production of essential munitions was made possible only by the development of new sources of power, together with the fullest utilization of that already available.

Although power surpluses will occur during the transition from war to peace, it is already apparent that the industrial potential of this country will play an important part in the reconstruction era. Despite the addition of more than two million horsepower during the war to the existing installations, new sources are now being sought to meet the requirements of agriculture and industry. Among the more important projects now under consideration is one in the Columbia River, British Columbia. By reason of the many factors involved, it is estimated that aerial photography will enable the survey to be undertaken at a cost of $400,000, as against an estimated cost of $1,000,000 by other means. (The area of the Columbia River basin in Canada is 39,000 square miles, while that in the United States is 220,000 square miles, which gives some conception of the task involved!)

Large-scale maps are required to determine the contours, and thus to establish the location of power sites. It is also necessary to consider the area that will be inundated, following the erection of dams, as well as the volume of water storage. The creation of a large reservoir thus, in turn, involves the relocation of roads on higher levels and introduces many legal considerations. Measures, too, must be taken for the prevention of floods.

Water from the storage area will be made available for the irrigation of territory in southern British Columbia that is presently unproductive, thereby enlarging the scope of this undertaking and requiring the examination of many air photographs to determine the location of ditches and sluices. Navigation facilities on the Columbia River will be affected, and the tourist industry stands to benefit materially through the completion of this project, in much the same way as it did in the area adjacent to Boulder Dam in the United States. Power produced, whether utilized in Canada or across the "Line", will provide for industrial expansion on a large scale, and result in an increase in employment and the enlargement of communities in sparsely settled areas.

Aerial photography, undertaken primarily for the preparation of maps for resource development, has provided reasonably ac-

Right:—Anderson Falls, on the Lockhart River, Northwest Territories. This stream, which has a descent of 700 feet in 25 miles, and enters the east end of Great Slave Lake, is a potential source of hydro-power for Yellowknife and other mining areas of the Northwest Territories. Aerial photography has furnished much accurate information on available heads of water.

curate information concerning the great potential hydro-power in the Northwest Territories adjacent to the Mackenzie watershed. One case might be cited in this connection: following a power survey of the Yellowknife River in 1937, a dam was established at the outlet of Bluefish Lake, twenty miles north of the settlement, and power was delivered to the Con, Rycon and Negus mines in mid-January, 1941. In other large areas, aerial methods have assisted in establishing the fall of the principal rivers and their drainage areas. It is also maintained that photographs will reveal where diversions can be effected to produce a greater head of water, if required.

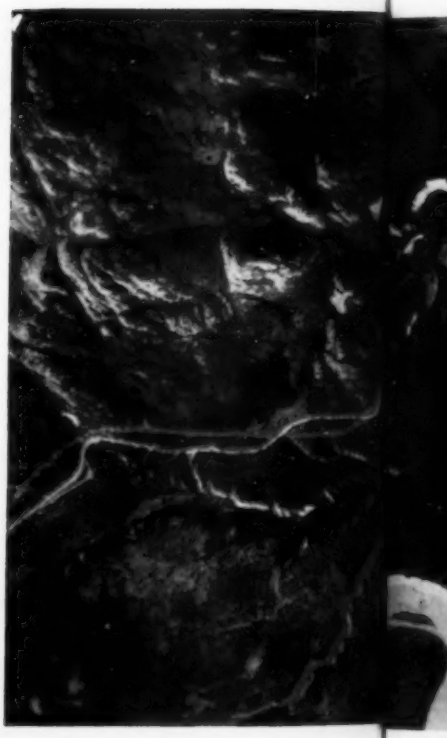
The development of Canada during the last four hundred years can be traced to the recorded observations of explorers, engineers, scientists and technicians. Their horizon was narrow, and progress was limited accordingly to the volume of detail they could accumulate in any given period. Aircraft have greatly broadened the horizon, and introduced to an army of specialists the means of securing a wealth of information with little delay. They are thus enabled to prepare a pattern for the further development of this Dominion, and to offer constructive suggestions for the employment of capital and labour in the field, forest and factory. In the past, data secured on the ground could be checked only after additional trips had been made into the areas concerned, and was generally inadequate for more than one purpose. Now, however, aerial photographs can be made available to a large class of engineers, scientists and technicians, assisting them in laying the foundations for various projects of a reconstructional character, and in pointing the way to prosperity through gainful employment for a large number of Canadians.

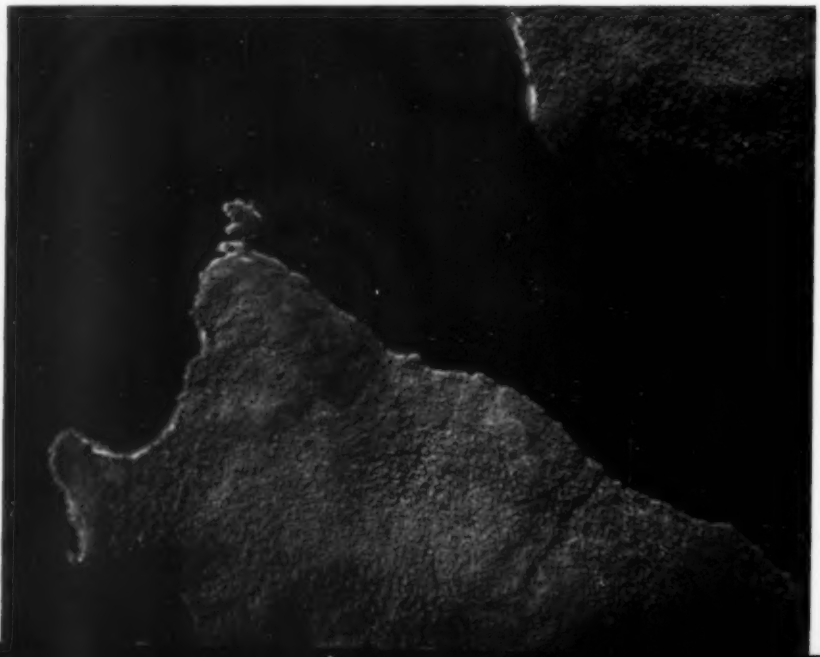
LEFT OBLIQUE

RIG

VER TOGRA

Section of Queen Charlotte Islands, British Columbia. Photograph used for topographic, hydrographic and forest surveys.





The three photographs, at centre and top of these pages, were taken simultaneously from the nose of a Mitchell aircraft flying at 20,000 feet, and present a panorama from the horizon on the port side to the

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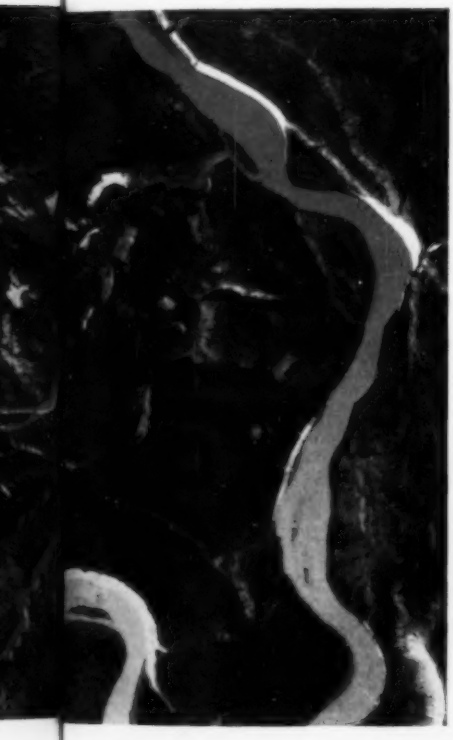

Malpeque Bay, Prince Edward Island. Such photographs provide data for hydrographic and topographical surveys, and assist in the drawing of leases for oyster beds.

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horizon on the starboard, as exposed to the camera lenses. They portray a section of the Alaska Highway, near Takhini River Bridge, west of Whitehorse. (Overlap may be noted.)

Mediaeval Coventry

by E. W. PITT

WHEN writing about Coventry, it is difficult to avoid mentioning the first great sacrifice made by British people during World War II. For this was the first of our towns to take something of what came to Warsaw, Rotterdam, Belgrade and Kiev.

Those who stood with the Dean and his officials in Bailey Lane, those who, though elderly and unaided, climbed high upon the flaming roof of the Cathedral, those who sheltered in the crypt and heard the whole of this great fabric hurling itself down from above—these know that, as always in war, the best was being taken in surety for the whole. The cinemas stand, as do the multiple stores and the villas, but not the four aisles, the pentagonal apse, and the chapels of the Drapers and the Girdlers, the Cappers and the Mercers, the Dyers and the Smiths. Years have passed over these and those adjoining them; judgement is no longer given in St. Mary's Hall, nor virtue rewarded in the hospital; and the Cathedral itself, with its tower and spire still reaching one hundred yards above the city centre, remains a sight to arrest the eye.

Dugdale, the great historian of the Midlands, tells us of a sack by the Norsemen under Knut in 1016. Later in the eleventh century the history of the town was continued with the foundation by Leofric, Earl of Mercia, and his wife, Godgifu (Godiva), of a house for an abbot and twenty-four monks under the Benedictine rule in 1043. At about this time the town was divided under two controls, known as the "Prior's Half" and the "Earl's Half"—a condition which dominated the fortunes of the townsfolk in those far-off days in no small degree. Earl Leofric, it is said, was always heavily taxing his folk of Coventry, and one day, in reply to the protests of the people and the admonitions of the Prior, he told his wife he would remit a heavy exaction if she would ride naked through the streets; thus resulted the well-known story which figures prominently in the rich annals of Coventry.

The growth of the abbey and its riches brought with them disputes with the local clergy. From 1095, for a century, there were bishops of Coventry; then the See was united to Lichfield, and so remained until 1836. Disputes between the Prior and the Earl were fairly frequent, much to the annoyance, we can well imagine, of the inhabitants. Hugh of Nunant (1188-98) had mighty contests with his monks, who eventually conquered him. Then the abbey flourished. Fragments of its buildings still remain by St. Michael's churchyard.

Two other features of the mediaeval life of the city must be noted: the overlordship of the Earls of Chester (evidenced by some stone remains of the old Cheylesmore Manor House in the southeast) and the great trading period, when the guilds of Coventry were among the foremost in the kingdom. By the end of the thirteenth century the guild merchants had won victories over both the lay and ecclesiastical lords, and in 1295 two of its burghers attended Parliament. Evidence of the rise and power of the guilds is seen to-day in St. Mary's Hall (1340).

Each important guild had its own chapel in the Cathedral or other churches, in which the guild chaplain said mass for its members on certain days of the year, conducted requiems for deceased members, and so on. It was the custom in mediaeval times for each trade to function as a whole in one or more streets, or to have a special area alloted to it in the market place. Before the carrying out of the Civic Centre Improvement Scheme, launched in 1935, these streets were called rows; there were Butcher, Little Butcher and Ironmonger Rows. To the former Bull Ring (also swept away in the improvement scheme), the farmers from the surrounding farms brought their cattle to be sold.

A writer in 1914 gives us a glimpse of life in the town prior to the First Great War.

The author of this article wishes to make acknowledgement of the assistance of Mr. Levi Fox, Coventry City Archivist.

"There are few towns", he writes, "which at the centre of modern business retain so much of what is ancient. One custom, as I learnt as long ago as 1883, indeed survives, which shows that it is not only old churches and houses and halls which recall an unbroken history. To this day animals are slaughtered in the open street, at Butcher Row, and that thoroughfare, with the ancient channel in the middle of the roadway, still runs with blood every Thursday during the hours alloted to slaughter by old Charter, not yet superseded by Acts of Parliament."

Twenty years after the above quotation was made, the city authorities decided to make a clean sweep of the core of the old town—the narrow, congested alleys, the picturesque tumble-down, rat-infested property and the small, unsavoury inns. In place of all this, one broad, beautifully paved thoroughfare was cut, on each side of which were erected up-to-date and efficient stores—destined to function, alas, only for too short a time, for ever since November 1940 this thoroughfare has been a mere ruin.

Another sad loss brought about by the enemy raids of that month was the total destruction of one of the most attractive of Coventry's several fine architectural pieces; viz., the group of buildings comprising what was known as the Palace Yard in Earl Street. This was erected by a wealthy merchant of the town in the seventeenth century. It was a quiet and charming house, with everything handsome about it that merchants liked in those days, good leadwork and a beautiful plaster ceiling. A the time of the Gunpowder Plot, in 1605, Princess Elizabeth, daughter of James I, was brought from Combe Abbey to Coventry for safety. James II held court here in 1687, and the Princess (afterwards Queen) Ann and her husband were lodged in the Palace Yard.

St. Mary's Hall: In the narrow thoroughfare called Bayley Lane, only a few hundred yards from the busy city centre, are two of Coventry's most historic buildings: the Cathedral of St. Michael, already referred to, and St. Mary's Hall, one of the finest specimens of mediaeval guildhall in England. It was the old-time centre of civic life and was called the "Chamber of Princes" when princes were more frequent visitors than they have been recently. The building was started in 1394, completed in 1414 and rebuilt in 1580. It was the assembly hall for the United Guilds of the Holy Trinity, St. Mary, St. John the Baptist and St. Catherine. It took its name from the first of these guilds to be founded (1340)—St. Mary's, or the Merchants' Guild. On the suppression of the guilds in the early sixteenth century, the Hall, with other guild possessions, passed into the hands of the Corporation, and since then has been, and still is, used as the Town Hall of the city for all important civic activities.

The building is entered by a porch with vaulted roof. On the keystone of the doorway is a carving representing the Coronation of the Blessed Virgin Mary, patroness of the Merchants' Guild. The Annunciation of the Blessed Virgin is represented on the impost of the inner arch on the right side; opposite this is a collection of grotesque animals. On the right side of the courtyard (Fig. I) is the crypt under the great hall,

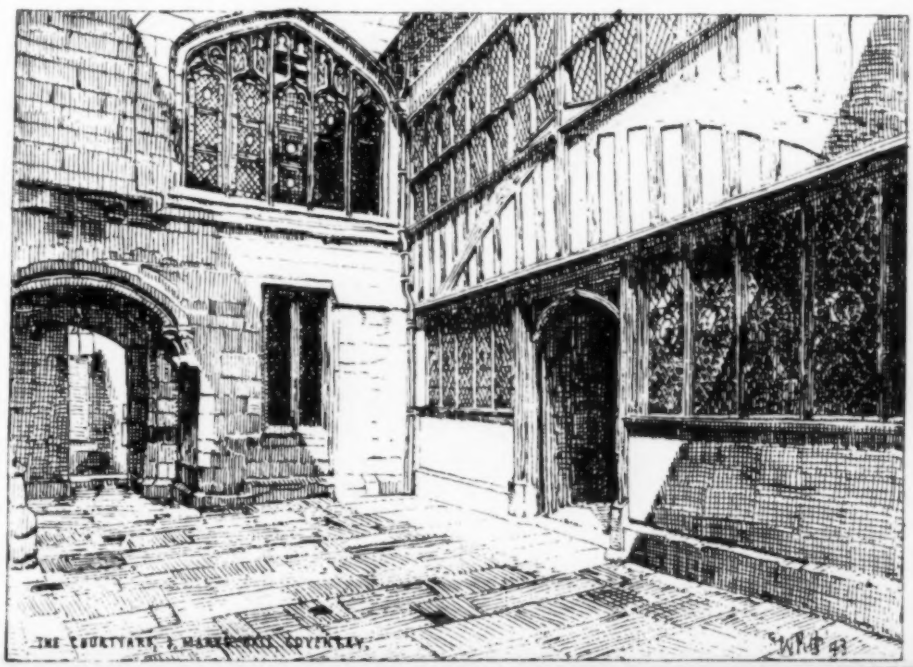


Fig. 1:—The courtyard, St. Mary's Hall

consisting of two chambers, a larger and a smaller, the former vaulted in eight bays. Across from the entrance to the courtyard, and at right angles to the crypt, is the kitchen—formerly the hall of the Merchants' Guild. On the left of the courtyard is the entrance to a lobby in which is a statue, supposedly intended for Henry VI. This statue was part of the "cross", and was brought here when that ornament of the city was taken down in 1771. The cross was situated in Cross Cheaping, and was, according to Dugdale (who supports his statement by a picture which shows that he was not saying too much), "one of the chief things wherein this city most glories, which for workmanship and beauty is inferior to none in England". Begun in 1541 and finished in 1544, it was erected in pursuance of a bequest of two hundred pounds made by Sir William Hollies, one-time Lord Mayor of London.

Near this figure, and at the side of the staircase, is a small doorway leading into the muniment room, which contains a singularly valuable and interesting collection of charters and other documents relating to the city, many of which are exposed to view in glass cases. After passing up the staircase and through an upper lobby hung with Flemish tapestry, one reaches the Great Hall (Fig. 2), which is 70 feet long, 30 feet wide and 34 feet high. The fine carved oak roof, says Sharp, "exhibits, on the centre of each beam, admirable whole-length figures of angels playing on various musical instruments; viz., the cruth, trumpet, littern, harp and base flute". The hall is lit by seven perpendicular windows, one of which, on the north, contains ancient glass, considerably restored, bearing a number of coats-of-arms and figures of different kings. The glass of the other six windows is modern. Some of the glass taken from the north window when it was restored in 1893 is in the oriel, a projection on the left-hand side of the room containing a carved buffet of the fifteenth century and some of the old tiles with which the hall was paved until, in 1755, it was floored with wood.

A doorway on the north side of the oriel leads into a passage contained in the thickness of the wall, which originally led to a gallery on the outside of the building from which the decisions of the courts used to be announced to the citizens below. At the south end of the hall is the minstrel gallery, from which leads off a room which was originally the armoury. At the front of the gallery are a number of pieces of armour, and beneath it are doorways leading to the council rooms. The most interesting object in this hall is the Arras tapestry, probably late fifteenth or early sixteenth century. It is also adorned with a number of portraits, among which are those of royal personages.

The Mayoress' Parlour is approached by a door exactly opposite the oriel, from which there is a short flight of stairs. Tradition states that Mary, Queen of Scots, was imprisoned in this room. It contains portraits of Queen Mary by Antonio Mori, of Queen Elizabeth and also of Lady Godiva's ride. It also contains a finely carved oak seat, surmounted by the city arms and the elephant and castle. The earliest mention of this chair was in the year 1560.

Bond's Hospital (Fig. 3) was founded in 1506 by Thomas Bond (Mayor of Coventry

Fig. 2:—Interior of St. Mary's Great Hall

ig. 3:—Bond's Iospital

in 1497) as an almshouse "for ten poor men, as long as the world shall endure, with a woman to look to them". The foundation now supports a considerably larger number of pensioners.

This timber-framed building, some 118 feet long, occupies the north side of a pleasant quadrangle lying at the back of St. John's church, and is a fine specimen of early Tudor architecture. Its frontage is pierced by a series of well-placed mullioned windows and gables richly ornamented with carved barge boards. Most of the building is original, but some restoration, especially of the interior apartments, took place just over a century ago under the supervision of two able architects, Messrs. Rickman and Hutchinson. The interior is commodious and admirably fulfils the purpose of an almshouse. It abounds in interesting features and contains priceless antique furniture.

Ford's (or Greyfriar's) Hospital (Fig. 4), standing a little below the junction of Warwick and Greyfriar's Lane, has been almost universally acclaimed as one of the most perfect specimens of sixteenth-century domestic architecture in the whole of the country. It was founded in 1529 by William Ford (merchant) of Coventry, and William Pisford, for six old men and their wives "being nigh unto the age of three score years and above, and such as were of good name and fame, and had been of good honesty and kept household within the said city, and were decayed and come to poverty and great need". Nowadays, only old women profit by the worthy merchants' benevolence.

The frontage of the building to Greyfriar's Lane is 40 feet long and consists of two floors, from the upper of which project three large windows with gables decorated with richly carved barge boards and pendants. The main door, leading into a small rectangular court, bears on its keystone a carving representing the Coronation of Our Lady, and on one of the stones, whence the inward arch springs, is a carving of the Annunciation, now almost unrecognizable, except that on the inner side the feathers of St.Gabriel's wings can be clearly made out.

To the right of the courtyard, underneath the Great Hall, is the entrance to the crypt, two beautifully proportioned chambers with a plain groined roof. In the end chamber or "tavern" is a fine carving of a lion. On the western side are the cupboard-like openings in the wall intended, no doubt, to store the deeds and valuable property belonging to members of the guild.

Fig. 4:—Ford's Hospital

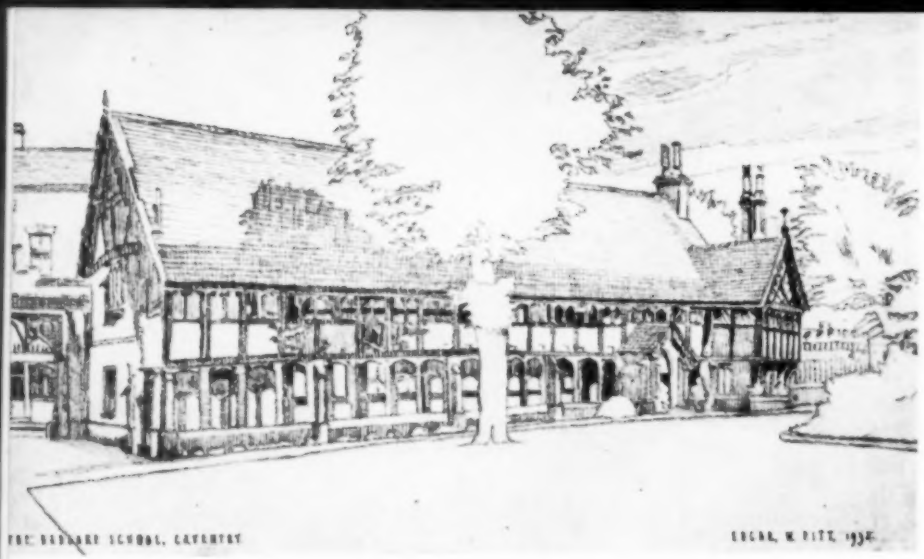


Fig. 5:—Bablake School

On the south side of the courtyard is the fourteenth-century kitchen. Here is the old whipping-post, and in the roof is an ancient louvre or smoke-vent. In the window stands a statue which came from the market cross, mentioned above. It probably represents Henry VI. The arches on the north side bear richly sculptured figures of angels, each holding a shield on which is a merchant's mark, bearing the initials J.P. (i.e., John Perry, living 1392—a benefactor of the guild).

Until it was seriously damaged by enemy action in the late war, the structure as a whole remained practically in its original condition. Fortunately, most of the timber frame-work has survived, so that there is every prospect of its restoration in its original form in the future.

Bablake School (Fig. 5): The good timber-framed building occupying the east side of Bond's Hospital quadrangle was built in the year 1560 as the Bablake Boys' Hospital, and in 1563 was endowed as a school by Thomas Wheatley, Mayor of Coventry in 1556. The school has been removed to another part of the city and the building is now a museum. Like Bond's Hospital, this is of good proportions, strongly built and embellished with finely carved woodwork and decorations throughout. It has a cloistered walk and gallery on the side facing the quadrangle, and, apart from some restoration work undertaken just over a century ago, the building retains its original features. In the ground-floor room to the left of the entrance doorway is a fine Jacobean mantle-piece brought from Sir Orlando Bridgeman's house in Little Park Street.

Priory Row Cottages (Fig. 6): Little is known of the origin of these timber-framed buildings. All that can be stated with fair certainty is that the group was built about the middle of the sixteenth century and the corner cottage earlier. The three cottages now known as Nos. 3, 4 and 5 Priory Row were originally one house called the Lych Gate House. The corner house was demolished in the improvement scheme of 1936-37, when Trinity Street was made. At the time of its demolition, two ancient doorway recesses were discovered in the basement wall under the west end of No. 3 Priory Row; the probability is that these formed part of the original buildings of the Benedictine Monastery founded by Leofric and Godiva on this site in 1043. The bases of a few pillars and the wall of the west end of the nave of the monastic church can be seen exposed at the east end of No. 5 Priory Row.

Fig. 6:—Priory Row

Yellowknife, 1945; the settlement has expanded southward, but building space on the rocky site is scarce. The building at the lower right is a theatre. Many people were living in tents.

Exploration and Settlement of Mackenzie District, N.W.T.

by M. J. and J. L. ROBINSON

(PART II)*

Scientific Exploration, 1850-1900

While missionaries and traders were establishing their permanent centres of activity throughout the District, there were other men who entered the area purely for exploratory purposes. After 1850, when the major geographic features of Mackenzie District were known, exploration followed a different theme. The incentive was no longer the thrill of first discovery or the urge to penetrate into the unknown. Travel and exploration followed broader scientific lines. Exploration became a search for knowledge—a search which slowly accumulated facts concerning botany, wild life, geology and similar branches of descriptive science, until Canadians began to realize faintly that this region was not all as desolate and wild as they were wont to picture it.

Among the trained and amateur scientists who assembled information about bird life and botany of Mackenzie District, two of the most notable were Robert Kennicott (1859-62) from the Smithsonian Institution, [14] and Roderick MacFarlane (1862-65) of the Hudson's Bay Company. [15] Animal life, especially musk-ox, in the area north and east of Great Slave Lake, was investigated by Warburton Pike (1889-90),[16] Frank Russell (1892-94), Caspar Whitney (1895) and C. J. Jones (1898).

Extensive botanical and geological notes were made by David Hanbury in 1899 when he discovered a new route from Hudson Bay to the Mackenzie Valley via the Thelon River. In the spring of 1902 Hanbury and a group of Eskimo crossed overland by dog-team from Baker Lake, Keewatin District, to Pelly Lake on Back River, continuing on to the Arctic Coast. Hanbury was thus the first white man to cross this interior region,** and throughout the journey lived principally on caribou, which were then migrating northward.[17]

[14] Preble, E. A.—"A Biological Investigation of the Athabaska-Mackenzie Region", *North American Fauna, No. 27*, U.S. Dept. of Agriculture, Washington, 1908.

[15] MacFarlane, Roderick—"On an Expedition down the Begh-Ula or Anderson River", *Canadian Record of Science*, January, 1890.

[16] Pike, W.—*The Barren Ground of Northern Canada*, London, 1892.

[17] Hanbury, D.—*Sport and Travel in the Northland of Canada*, London, 1904.

*See June issue of the *Canadian Geographical Journal* for Part I, describing early exploration and the first settlements of traders and missionaries.

**Hanbury's route was similar to that followed by the Canadian Army's "Musk-Ox" snowmobile expedition.

There were many government-sponsored explorations during this same period which, although primarily geological in character, resulted in excellent descriptive reports of flora, fauna, and other resources.* One of the first regional studies of the Mackenzie Valley was made by R. G. McConnell of the Geological Survey of Canada, who spent the seasons of 1887-88 travelling throughout the Valley. In the summer of 1888, William Ogilvie, Dominion Land Surveyor, crossed from the Yukon, passing McConnell near Fort McPherson, and ascended the Mackenzie, making careful notes as he travelled. In 1891, Ogilvie journeyed down the Athabaska, Slave, and Mackenzie Rivers to Fort Simpson, and from there ascended the Liard and Nelson Rivers. His report contains some of the earliest descriptive material of the southwestern part of the District.

The southeastern part of Mackenzie District was explored in 1893 by J. B. and J. W. Tyrrell of the Geological Survey. They portaged from the east end of Athabaska Lake to the headwaters of Dubawnt River, and became the first white party to traverse this central section of interior Canada to the head of Chesterfield Inlet. In 1900 J. W. Tyrrell followed Hanbury's route east from Great Slave Lake and alone explored much of the interior country east of Artillery Lake.

In the summer of 1899 Dr. Robert Bell, and his nephew, J. Mackintosh Bell, investigated the geology of the North Arm of Great Slave Lake. After wintering at Fort Resolution, J. M. Bell proceeded north to Fort Norman, where he was joined by Charles Camsell. Their geological party then travelled along the shores of Great Bear Lake in the summer of 1900, and noted the famous "stains of purple, red and brown" which were later to lead to the discovery of pitchblende.

By the turn of the century Mackenzie District was no longer an unknown country. As news of gold in the Yukon travelled south, prior to the Klondike strike, prospectors and other hardy adventurers turned their eyes to the North. The good water route north of Edmonton through the Athabaska and Mackenzie Valleys was known, and this broad trail, linked with the crossing from Fort McPherson to Porcupine River, became the "back door" to the Yukon. Since more and more people were entering the area, some of whom remained to trap or trade, the pioneer land was ready for the next step in its evolution—the coming of some form of supervision and government.

*Published in the Annual Reports of the Geological Survey of Canada.

TWO PRESENT-DAY R.C.M.P. DETACHMENTS

R.C.M.P. at Fort Smith. The buildings are situated in the centre of a nine-hole golf course.

R.C.M.P. at Fort Providence. Dwelling is seen in the centre and dog-kennels to the right.

Residences constructed by the Imperial Oil Co. Ltd. for single girls at Norman Wells.

Royal Canadian Mounted Police

The Royal Canadian Mounted Police (then the North West Mounted Police) were formed in 1873 with the duty of maintaining the law in the vast areas of the Northwest, recently acquired from the Hudson's Bay Company. Throughout the following two decades the "Mounties" were the chief governing officers in the Prairies during the hectic years when settlers were pouring into the fertile lands. Their work gradually spread northward, and in 1895 a police post was established in Yukon District. The increasing flow of prospectors to the Yukon was actually the reason for the first police penetration of what is now Mackenzie District.

During the winter of 1897 Inspector A. M. Jarvis led a pioneer patrol north from Fort Saskatchewan (near Edmonton) along the Athabaska and Slave Rivers to Fort Resolution to check on itinerant trappers and to prevent carelessness of travellers in starting forest fires. In 1902 the force moved one more long step northward when a detachment was placed at Fort Chipewyan. From there several patrols covered the southern part of Mackenzie District during the succeeding years.[18]

American whalers, who had extended their operations eastward along the Alaskan Coast, began wintering at Herschel Island in 1890. Their uncontrolled, and often riotous, activities during the next decade led to reports which necessitated investigation. In the summer of 1903 Sgt. F. J. Fitzgerald boarded the *S. S. Wrigley* at Fort Smith and travelled downstream to the Hudson's Bay Company's most northerly post at Fort McPherson. He continued by canoe to Herschel Island and issued instructions to the whalers regarding customs and liquor regulations. Fitzgerald returned to McPherson in the autumn to open a detachment there, and in the following summer established the most northerly police post on Herschel Island. During the succeeding years, officers from these two centres administered all of the northern part of the Mackenzie Valley and the nearby Arctic Coast.

In the southern part of the District, the police placed a detachment at Smith's Landing (now Fort Fitzgerald) in 1908 to protect the buffalo herds west of Slave River. In the following years patrols visited the growing settlements of southern Mackenzie District. In 1913, however, it was decided to locate detachments at Forts Resolution and Simpson to reduce the long distances travelled. In 1916 a detachment was established at Fort Norman to connect the northern and southern patrols.

Space does not permit mention of all the long and important patrols made by the police officers during the years prior to 1921 when they were responsible for the administration of the region.[19] One of the most famous annual patrols was that through the northern Mackenzie Mountains from Dawson City, Yukon, to Fort McPherson via Peel River. The difficulty of this patrol, through an area where game was uncertain, was illustrated in 1911 when Inspector Fitzgerald and his three companions became lost and starved to death. The longest overland patrol of the police took place in 1917 from Baker Lake across the Barren Grounds to the Arctic Coast, and thence westward to the headquarters of a trader at Bernard Harbour, north of Coppermine. On the return trip the police were on the verge of starvation several times, but each time were able to kill a few caribou or musk-ox just when the situation seemed almost hopeless.

The end of the period of unorganized development saw the police located at a few strategic places along the Mackenzie Valley and Arctic Coast, thereby controlling the main transportation routes, so that they knew who entered or left the region. By

[18] Fetherstonhaugh, R. C.—*The Royal Canadian Mounted Police*, New York, 1938.

[19] Steele, H.—*Policing the Arctic*, Toronto, 1936.

Panorama of Hay River settlement, looking south from the Roman [illegible]n. Co

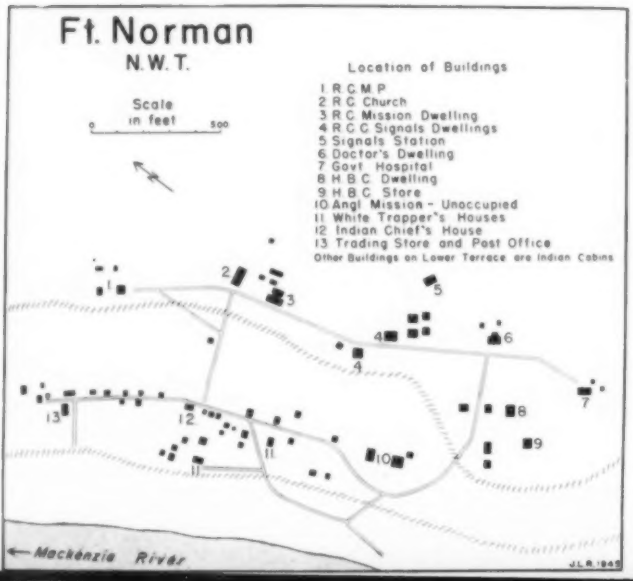
CHRONOLOGY OF FIRST SETTLEMENT IN MACKENZIE VALLEY*

Settlement	Trading Posts**	Missions	R.C.M.P.
Fort Smith	H.B.C.—1874	R.C.—1888 Ang.—1929	1921
Fort Resolution	N.W.C.—1786–87	R.C.—1858	1913
	H.B.C.—1804	Ang.—1890–95	
Fort Reliance	H.B.C.—1833–35		1927
Rae	H.B.C.—1852	R.C.—1872 Ang.—1876–1880	1924
Hay River	H.B.C.—1868	Ang.—1893 R.C.—1900	1925–33
Fort Providence	H.B.C.—1868	R.C.—1862	1924
Fort Simpson	N.W.C.—1804	Ang.—1858	1913
	H.B.C.—1820 (1822)	R.C.—1894	
Fort Liard	N.W.C.—1805	R.C.—1871 Ang.—1887–92	1929
Fort Wrigley	H.B.C.—1877	R.C.—1897	1932–33
Fort Norman	N.W.C.—prior to 1810	Ang.—1866–68, 1876 R.C.—1876	1916
Fort Franklin	N.W.C.—1805–15		
	H.B.C.—1825–27, 1864–72		
Fort Good Hope	N.W.C.—1805	R.C.—1859	1924
Arctic Red River	H.B.C.—1891	R.C.—1896	1926
Fort McPherson	H.B.C.—1840	Ang.—1876 R.C.—1890–96	1903–22
Aklavik	H.B.C.—1912	Ang.—1919	1922
	N.T.C.—1912	R.C.—1926	
Herschel Island	Whaling—1890–1914	Ang.—1896–1903	1904–1936
	H.B.C.—1916		

N.W.C.—North West Company R.C.—Roman Catholic R.C.M.P.—Royal Canadian Mounted Police
H.B.C.—Hudson's Bay Company Ang.—Anglican N.T.C.—Northern Trading Company

*Dates given usually refer to the establishment of permanent buildings. In some cases visits were made prior to this, and frequently the buildings were later abandoned. For changes in sites, or posts which were abandoned, see map on page 253, June issue.
**After amalgamation in 1821, many N. W. C. posts were occupied by the H. B. C.

means of their long patrols in summer and winter they linked their work and covered most of the populated sections of the District. By the end of 1920 detachments were patrolling from Forts Fitzgerald, Resolution, Simpson, Norman, McPherson, and Herschel, and from Tree River.



During the first two decades of the present century numerous independent traders entered the Mackenzie Valley. Some settlements had as many as three or four trading stores at one time. The leading concern in opposition to the historic Hudson's Bay Company in 1905 was the Hyslop and Nagle Trading Company, which had stores located in seven settlements, and operated its own steamer. Eight years later this company was bought by the Northern Trading Company, which soon placed posts throughout the Valley as far as Aklavik. Competition was keen in those years and the police were kept busy controlling trading and trapping practices.

The various dwellings, offices, and warehouses which were erected by the police and traders from 1900 to 1920 helped to swell the size of each tiny settlement. Whereas the original post consisted solely of a trading

on. Compare this picture with the map of buildings at the settlement.

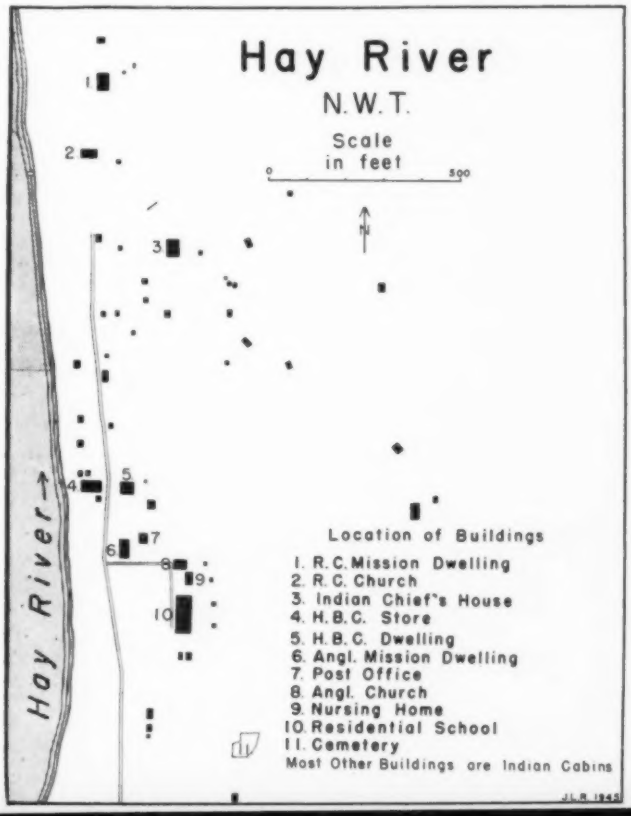
store and a group of Indian tents, the settlements of 1920 had a cluster of white men's residences of various kinds and numerous Indian cabins. Although southern Canadian towns also went through these same stages of adding organizations and buildings step by step, their expansion period often lasted only a few years. In Mackenzie District the slow growth of the original post to the status of a small settlement was measured in decades rather than years. (See the chart of first settlement on preceding page.)

Western Arctic Settlement

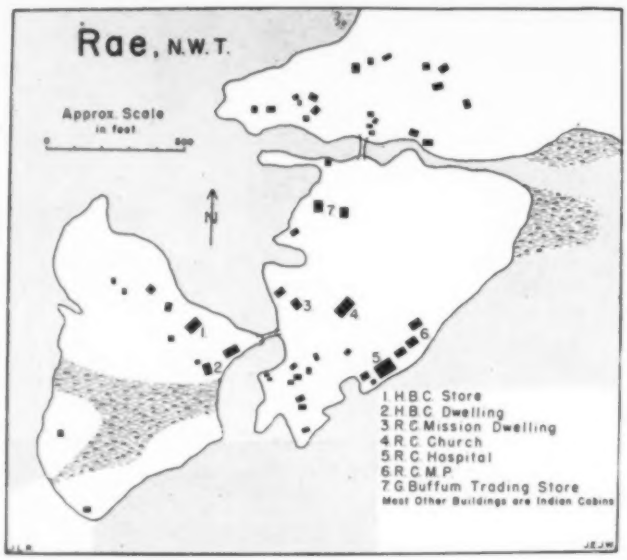
Soon after river-steamers reached the Arctic Coast, small coastal motor-vessels began moving eastward from the Mackenzie Delta area. Traders seeking white-fox pelts from the natives were first to settle permanently in Eskimo country, and they were followed by missionaries. Trading with the Eskimo was carried on by the whalers wintering at Herschel Island and Baillie Island, and by 1906 Captain C. Klengenberg had penetrated as far east as the coast of Victoria Island. A few years later Captain J. Bernard had located a store at Bernard Harbour (1911-14). By 1920 several traders and the Hudson's Bay Company were operating along the coast of Coronation Gulf as far east as Kent Peninsula. An Anglican Mission was established at Bernard Harbour in 1916, and in later years missions were opened at other Western Arctic posts (Cambridge Bay, 1927; Coppermine, 1928).

It was in order to supervise the increasing activity of the traders that the R.C.M.P. decided that they should move closer to the area. In 1919 a detachment was opened at the good harbour of Tree River, east of Coppermine River. From here patrols were made along the Arctic Coast and across to Victoria Island. The number of detachments was increased in the following years to complete a line of police posts along the Arctic Coast: Baillie Island, 1923; Bernard Harbour, 1926; Pearce Point, 1930; Coppermine, 1931.* The Tree River detachment was transferred eastward to Cambridge Bay in 1926 to give contact with the isolated Central Arctic Eskimo.

The traders continued their eastward movement along the Arctic Coast of Mackenzie District. In 1926 four trading-posts were opened in Queen Maud Gulf. The difficulties of transporting supplies to the Western Arctic were great, however, and the number of posts has gradually declined in recent years. The present settlements differ in appearance from those in the Mackenzie Valley in that they are much smaller, owing chiefly to the fact that, unlike the Indians,



*See Annual Reports of the Royal Canadian Mounted Police—"Control of the Northern Regions".



Eskimo do not build permanent homes around the posts.

Present-Day Settlements in the Mackenzie Valley

After more than a century of slow development, history began to move faster in Mackenzie District following 1920. This increasing tempo was due largely to better transportation facilities, which meant that more people could enter the area. In March, 1921, the first aeroplanes reached Fort Simpson, landing on skis, and that summer a float-plane was flown north to Norman Wells. By 1925 the railroad from Athabaska Landing was extended north to Waterways. In the same year wireless communication, operated by the Royal Canadian Corps of Signals, was established from Aklavik, Fort Simpson and Fort Smith. In the succeeding years this network was expanded until now every settlement has daily radio-telegraph communication with other parts of the world. By 1928-29, commercial air transport companies had entered the District in force to assist prospectors. The great strides in aviation made during the next decade were among the chief factors in bringing Mackenzie District into the limelight.

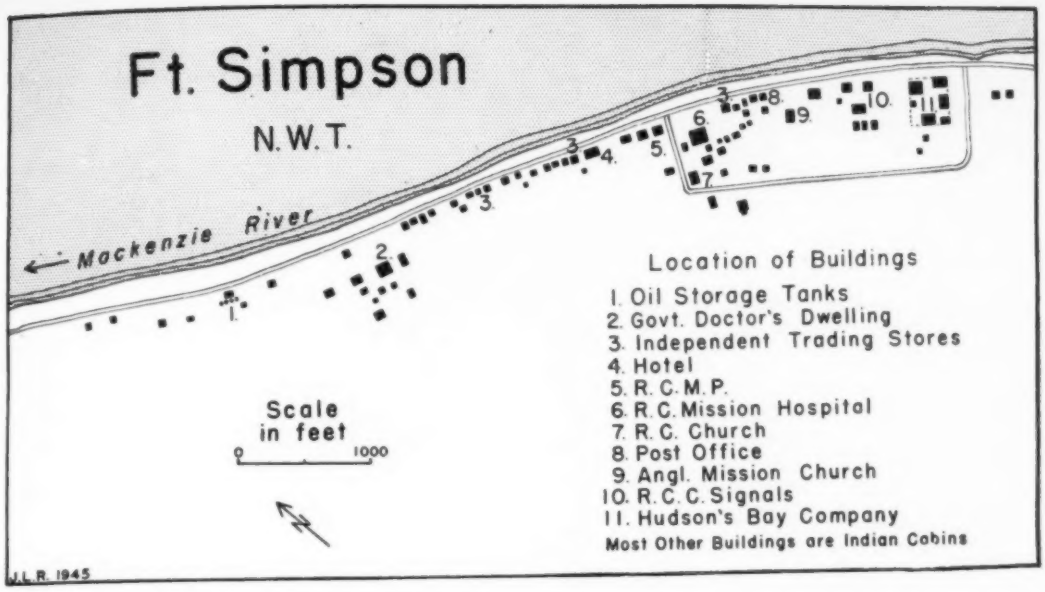
Present-day settlements in the Mackenzie Valley range in size and function from tiny Wrigley, which has remained solely a trading-post, to busy, booming Yellowknife, a modern town of over 2,000 inhabitants. To describe each of these settlements in detail would result in needless repetition, and the reader is referred to the accompanying pictures and settlement maps which show the sizes and types of buildings at several of the centres.

Some of the settlements can be grouped together as similar. Hay River, Providence, Liard, Norman, Good Hope and McPherson are linear-type settlements, extending along the river bank. They all contain the Police, Signals, trading, and missionary buildings, and a scattering of Indian cabins. There are from 10 to 30 white residents at each settlement, and, in the surrounding area, from 200 to 300 Indians who come into the settlement from time to time.* The settlements of Fort Resolution and Rae have grown up as a cluster of buildings grouped on the lake shore rather than spread out along a river. Fort Simpson and Aklavik are larger villages of the linear type, having more trading stores, a hotel, restaurant, and several resident white trappers. In all, there may be from 50 to 100 white residents in each of the latter settlements, and they have a social life similar to that of small towns in southern Canada. Fort Smith is still larger, containing Government administrative offices, and the warehouses and offices of the transportation companies. It has the beginning of a street pattern and is connected with nearby Bell Rock and Fort Fitzgerald by all-weather roads.

Norman Wells and Port Radium might be classed as company settlements controlled respectively by the Imperial Oil Co. Ltd. and Eldorado Mining and Refining. All of the residents dwell in comfortable, well-equipped buildings supplied by the companies, and their business is concerned solely with the companies' work. The population of these settlements varies according to the amount of activity at the oil wells or pitchblende mine, and is at present about 200-350, including women and children.

Yellowknife is the largest settlement in Mackenzie District. It came into boom-town existence in 1935-36 following the rich gold strikes in the area. Unlike similar gold-rush towns of a few decades ago, Yellow-

*Total population of the Mackenzie Valley in 1941 was 2,063 white residents and 4,322 Indians.



knife has had lawful, orderly, progress. In 1939 the Yellowknife Administration District was created and the first municipal government of Mackenzie District was established in the following year. The population of over 1,000 was clustered in variegated frame buildings around the knoll of a rocky peninsula jutting into Yellowknife Bay. In 1941-42 there were six producing gold mines in the area, but a shortage of labour gradually forced them to suspend operations temporarily.

In 1944 a new rush to the Yellowknife area followed reports of discoveries on the Giant Yellowknife property. By 1945 there was a population of about 3,000 in the town and surrounding prospecting area, and there was an infectious spirit of busy optimism and friendliness about the settlement. The town was very crowded, however, and although Yellowknife tried to satisfy the needs of this most recent influx with the well-known friendly hospitality of Mackenzie District, it was impossible. The townsite had outgrown its location, and a new site was surveyed in 1945 on a level area about two miles distant from the present settlement.

Yellowknife is a mining town similar to many others in the Canadian Shield of Northern Ontario or Manitoba. It has daily plane service in summer from Fort Smith and Edmonton, and supplies are shipped in by boat in summer and by tractor-train in winter. To serve the local population, there are numerous restaurants, banks, general stores, barber shops, etc.*

Yellowknife is an example of how small settlements like those in Mackenzie District can grow in importance and size if some resource is found to assist historical evolution. If history and geography are combined one has a sound basis for understanding the reasons for growth and the future possibilities of a settlement. Certain sites were picked because of their strategic locations which opened the way to new regions; other locations were chosen because of their resource possibilities—chiefly good fishing or hunting.

Once the location of a post had become history, its normal growth depended upon new organizations entering the area. To expand beyond normal, however, necessitated some nearby resource which could be developed. Thus, Fort Simpson and Aklavik are larger than the other trading settlements because they are located in areas richer in furs. Similarly, owing to the barrier of the rapids in Slave River, Fort Smith became a transportation terminal and surpassed the settlements which depended mainly on fur. Finally, when a resource such as gold, pitchblende, or oil was found to compete in the world market, larger numbers of people assembled in the area to extract the wealth, and thus still larger settlements evolved. The history of a settlement explains its background and functions; the geography of the region in which the settlement is located points the way to its future.

* Prospective visitors and residents may obtain more detailed information concerning Yellowknife and facilities from the Bureau of Northwest Territories and Yukon Affairs, Dept. of Mines and Resources, Ottawa.

This technical operator in the overseas centre of the Bell Telephone Company at Montreal checks up on transmission for all radio-telephone talks between Canada and Britain. Here your voice is "scrambled" before being beamed across the ocean on radio short waves.

Overseas Calling Speeds Up

Service Now Available to 39 Countries

Nearly all overseas telephone calls are now being put through at the time appointed. The first big post-war rush has died down.

When the Montreal-London radiotelephone circuit reopened June 23, 1945, there was already a big back-log of calls filed in advance. The next few months found besieged traffic forces on both sides of the Atlantic battling to get calls through. Since priority went to government and business messages, social callers had to queue up and wait their turn.

As operators acquired experience, and conditions in Britain began to settle down, the number of calls handled per day has been increasing. Now that the volume of calls associated with the war effort has declined, and most servicemen are back home, speedy overseas service to the general public can be resumed once more.

Up to May 1, the Montreal-London circuit had handled over 8,000 calls—3,700 outgoing and 4,300 incoming.

Meanwhile, service has been restored to several countries, and extended to new ones.

The American Telephone and Telegraph Company has direct circuits to France, the Netherlands, Portugal, and Switzerland, over which service is available to and from Canada. Service to Moscow is confined to business calls. The rate to any of these countries is now only $12. except from British Columbia, which is $15.

In the Pacific, service has been resumed to Hawaii, the Philippines, Australia and Tasmania, via San Francisco. Service was opened to New Zealand for the first time on February 1. China, Java and Japan are still cut off.

Service to South America and the Caribbean has of course been available throughout the war, and has even been extended during the past six years. A direct circuit between Canada and Barbados was opened September 1, 1945.

Service is still suspended to Egypt, Gibraltar, Iceland, India, Irak, Kenya, Palestine, South Africa and Syria.

A Trans-Atlantic call from any point in Canada must pass through the overseas centre in Montreal. From there, the voice currents travel over wire lines to the Canadian Marconi Company's powerful beam transmitter at Drummondville, Que. There the electrical waves are amplified, changed into radio waves, and hurled across the ocean to Baldock, England.

These waves may be picked up by any radio receiver which is tuned to the proper frequency and is in the path of the beam. Therefore, the technical operator has previously "scrambled" the voice currents, so that radio eavesdroppers will hear something about as intelligible as Donald Duck using double-talk.

At Baldock, a receiving station picks up the beam, amplifies the currents once more, and turns them back into electrical waves. Carried by wires to London, the voice currents are unscrambled before proceeding to the distant telephone.

The English party's voice does not follow the same route as the Canadian's. After being scrambled, the voice current leaves London by wire lines for Rugby, where the British Post Office Transmitter beams it to Yamachiche, near Trois Rivières, Quebec. Then it goes by wire to Montreal, where it is automatically unscrambled and sent on to the subscriber's telephone.

Alternate Trans-Atlantic service is available via New York and service across the Pacific, to South America and the Caribbean goes via San Francisco, New York, or Miami.

EDITOR'S NOTE-BOOK

Society's First President Is Honoured

Last May The Royal Geographical Society announced that its Founders Medal for 1945 had been awarded to Dr. Charles Camsell (Honorary President of The Canadian Geographical Society) for his contribution to the geology and geography of the Canadian North and for his work in advancing geographical science in the Dominion. In 1922 the same Society awarded him the Murchison Grant for northern explorations.

To members of The Canadian Geographical Society—and, in fact, to Canadians in general—Dr. Camsell's name is symbolical of the scientific development of our vast northern resources. The honour paid to the Society's first President, who guided it through its formative years, will be welcomed by every Canadian.

* * *

Our Contributors

M. J. and J. L. Robinson—See June 1946 issue of the Journal.

* * *

Robert H. Ayre, Assistant Manager of the C.N.R. Press Bureau at Montreal, joined Canadian National Railways at Winnipeg in 1927, and has been associated with Trans-Canada Air Lines ever since its first year. Mr. Ayre is an experienced journalist, having served on the editorial staffs of the *Winnipeg Free Press* and the Montreal *Gazette*, in addition to which he has contributed to numerous magazines. He is at present co-editor with Donald W. Buchanan of *Canadian Art* magazine.

* * *

E. W. F. Pitt was born and educated in Birmingham, England. After an extensive training course in architectural history, drawing and design, he spent a number of years studying buildings of architectural and historical importance. He has also done a great deal of valuable work in connection with the surveying and recording of numerous buildings of aesthetic merit in England and the Near East. Mr. Pitt is greatly interested in archaeology and topographical art, has written many articles of architectural importance, and is represented in the Pilgrim Trust Recording-of-Britain Scheme by water-colour sketches of East London.

* * *

S/L J. Fergus Grant is well known to readers of the Journal—particularly for his articles dealing with the development of aviation in Canada. "Air Photographs Speed Reconstruction" provides an up-to-the-minute record of a vitally important Canadian achievement—a major contribution by the R.C.A.F., in its peacetime role, to our national economy. To this task the writer brings nearly two decades of intimate contact with Canadian aviation, having served as aviation and marine editor of the Montreal *Gazette*, as staff correspondent for the *Canadian Geographical Journal*, and as an officer in the R.C.A.F. during the war period. Mr. Grant's association with the men who have made Canadian aviation history, his extensive travels throughout Canada and flights in many parts of the world in the conduct of his work provided experiences which represent an excellent background for his present article.

* * *

AMONGST THE NEW BOOKS

Economic Demography of Eastern and Southern Europe

by Wilbert E. Moore

(A League of Nations publication distributed by Columbia University Press, U.S.A., $3.00)

This population study is set in the kind of framework most likely to result in useful generalization. It does not take mere numbers of population—e.g., that from time to time there have been so many pieces of material called human in Canada—as having an independent dynamic. It enters the phase of study which goes deeper than the fitting of curves to growth, or even than the projection of birth and death rates, which constituted the first of the present series of League of Nations studies; it adopts a more hopeful approach to how the motor car works than noting its size and the number of wheels. It raises up the hood to find the mechanism.

At the basis of human life in the most complex society is agriculture. Many have talked since Malthus

(*Continued on page IX*)

(*Continued from page VIII*)

of the pressure of population on the means of subsistence; this book is dedicated to a most serious attempt to find the relative intensity of pressure in that section of the western world where the population problem may most nearly be envisaged in classical Malthusian terms.

Inadequate data are a handicap in such a venture, but the author appears to transcend such difficulties. The problem is to find a measuring rod for "means of subsistence". Because the food values of the several crops are far from equal, it seems best to allow the market to decide, in terms of "crop baskets", what the production of each place is. We may think of a crop basket as consisting of one quintal each of five cereals and potatoes; all output, including that of the components of the crop basket, is taken in terms of it; the equation is in terms of modal prices in the several countries dealt with. This provides a fairly satisfactory measure of relative contribution to well-being for such varied foodstuffs as meats, roots, etc., which can then be added up. Agricultural production is thus measured in terms of physical production with different crops weighted according to generalized relative prices.

After due subtraction of feed and seed to secure the net available for human intake, the author refers the total to several bases. He finds production per person dependent on agriculture diminishing in the successive concentric arcs drawn about the British Isles. A similar pattern is shown in production per male engaged in agriculture and per unit of "arable-equivalent" land. Net production which takes account of fishing and forestry is a little more difficult to figure, but, calculated roughly and taken in relation to persons dependent on agriculture, seems to show the same pattern of concentric arcs enclosing diminishing amounts of production per person towards the south and east of Europe. Some comparable figures for Canada which would show where we stand in relation to the European hierarchy of efficiency would be more valuable than the crude population per square mile which is a popular index of overcrowding with some statisticians.

Due to the scarcity of data and its disjointedness, estimates are everywhere necessary, and writers boldly make and use estimates. To carry out this process, fully disclosing the assumptions by which the paucity of data has been bridged and providing suggestions for others as to where useful figures can be gathered in subsequent enumerations, seems as creative a form of work as a supposedly dry field affords.

Without prejudice regarding the relative merits of the method of calculation used and some alternative, one wonders in several places what would have been the result of figuring in some other way. An idea of the order of magnitude of differences in the results that would arise from variations in the basis is essential for a judgement of the work. Thompson and Whelpton's estimates of United States population are classics of this. While such variations do not in any rigorous sense provide a band of error, they are the nearest approach to that in this type of calculation.

The latter portion of the book is concerned with relevant aspects of social organization. Traditional rather than secular norms determine economic life in Eastern and Southern Europe. The influence of family, neighbourhood, church, and nation is stressed. The waste in idle or half-employed labour which so often characterizes this situation in its maturity is here presented. The waste of human energy and aspiration implicit in the combination of high birth and high death rates is clearly recognized.

The writer repeatedly refers to the subdivision of lands among the peasants who work them as lowering the national agricultural product in the attempt to distribute it. His belief that he has here provided "an excellent demonstration of the falsity of the thesis that technological changes are the primary determinants of social change" is patently incorrect. No one has said that inventions will always "take" immediately, and the proponents of the theory have, moreover, given much attention to the institutional conditions under which inventions are accepted. We have in Southern Europe an excellent instance of the pressure of technical change on a traditional economy. Can the local economy not be expected to resist, even at the cost of serious harm to itself, the new tendency to change? Landlord and taxpayer—the personnel through which such resistance is manifest—are hardly likely to abdicate on the arrival of the first American tractor. They naturally join with such diffuse and deep-seated social forces as the book accurately enough describes—the tradition of division of land among children, the desire of the peasants for a piece of their specific "own", the universal ignorance and hence distrust of the techniques of scientific agriculture—and with such economic realities as the lack of industrial "run-off" for surplus farm labour. It is a vicious circle of high fertility, excess labour, no large industry, low standard of life. Higher living standards would reduce fertility; industry would raise living standards and also take up the excess of labour; scientific agriculture would produce an excess of goods to exchange for industrial products, and industry would equip agriculture.

Professor Moore realizes that policy does not become determinate once the facts of a situation are laid out. He does, however, indicate the various lines of policy which could break the circle. He emphasizes that the sacrifice of some values—those associated with family, local tradition, nationality—would gain the value of a better livelihood. Political authorities can foster change by modes of planning that are familiar to the western world—marketing aids, suitable fiscal policies, education—as well as by security of employment for urban workers. Repetition of the pattern of western industrial development would be too slow; some planned acceleration is indicated.

NATHAN KEYFITZ

Canol

(The sub-Arctic pipeline and refinery project constructed by Bechtel-Price-Callahan for the Corps of Engineers, United States Army, 1942-1944.) Text and documentary photographs by Richard Finnie. Produced for Bechtel-Price-Callahan, San Francisco, 1945.

Richard Finnie is well qualified to write about the Canol (short for Canadian Oil) Project, for at an early stage of the construction (May, 1942) he was retained (with Mrs. Finnie as his assistant) by Bechtel-Price-Callahan as northern consultant, historiographer and official photographer. In this capacity he witnessed the construction of the road and pipeline from Whitehorse in Yukon Territory to Norman Oil Wells on the Mackenzie River. He saw it through its first awkward groping steps, when no one had very clear ideas about how to run a pipeline through an unmapped and practically unknown wilderness; saw it gather momentum and get into stride, scorning the Cassandras who said it could not be done; and surveyed the job successfully completed, all in an incredibly short time.

After a year with the contractors, the Finnies were taken over by the United States Army, to carry on as before, and to produce the two documentary films "Alaska Highway" and "Canol".

Finnie probably could write a very good "inside" story about the Canol Project, and some day he may. The scope and purpose of his present book is entirely documentary and permits him only nine short pages for the "background" of "the greatest construction job since the Panama Canal. In respect to area covered, time of accomplishment, and sheer pioneering, the pipeline and refinery project, combined with the Alaska Highway, was destined to become the biggest construction programme in the history of the world."

A truly staggering job it was, the full magnitude of which can only be grasped by one who has actually travelled the 1,600 miles of mountain wilderness, from Dawson Creek, British Columbia, to Fairbanks, Alaska, and the 500 miles from Whitehorse, Yukon Territory, across the jagged Pelly and Mackenzie Mountains to the Norman Oil Wells on the Mackenzie River; not to mention the thousands of miles of pioneer and winter roads built to bring in the 50,000 tons of supplies and equipment needed for the construction of the Canol pipeline.

The purpose of the book "is to highlight the problems, the difficulties, and the achievement shared by all of the Canadian and American men and women, military and civilian alike, who built the Canol Project". In this the publishers and the author have been singularly successful, for the 148 excellent full-page and well reproduced photographs, 42 of them in colour, tell the story in all its graphic detail, demonstrating "that modern machinery and equipment can, with ingenuity and experience, be worked as successfully in the Far North as elsewhere; that good roads, telephone lines, airports, pipelines and refineries can be built there, and towns too, where people may live in comfort and happiness".

In an appendix are listed the names of the many thousands of military and civilian personnel who served nine months or longer in connection with the construction of the Canol road and pipeline. A. E. PORSILD

(*Continued on page XII*)

The Mecca of Dickensians

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How Mexican Peanuts Make Jobs for Canadian Machinists

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9. Who, with the help of the Trade Commissioner, found him a buyer in Mexico for his machinery . . .
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10. But he needed protection against the credit risks and money to finance the big order . . . so he insured the deal with the Government's Export Credits Insurance Corporation.
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Hon. James A. MacKinnon, Minister — M. W. Mackenzie, Deputy Minister

(Continued from page X)

Saints, Devils and Ordinary Seamen

by LIEUT. (S) WILLIAM H. PUGSLEY, R.C.N.V.R.
(Wm. Collins, Sons & Co., Canada, Ltd., Toronto, $3.00)

Lieut. Pugsley joined the Royal Canadian Navy early in the war, and voluntarily resigned his commission to write the story of life on the lower deck. To this end, he served on twenty-odd ships and shore establishments, and probably saw as much of the war at sea as any Canadian.

The narrative is a well-written and informative account of the day-to-day life of the *matelot* at sea and on shore. The author is much concerned with the disparity between the living conditions of the officers and other ranks. He lacks, however, the gift for sharp characterization which would make living figures of his lower-deck friends, and his picture of their lives and thoughts is perhaps something on the prim side. We meet a surprisingly large number of saints, but the devils and ordinary seamen are greatly in the minority.

The above is a commentary and not a criticism of an honest and extremely readable book which provides an invaluable record of the Royal Canadian Navy and its personnel, and is accompanied by excellent illustrations.

P. E. P.

* * *

BOOKS AND PERIODICALS for the Devastated Libraries of Europe and the Far East

During the war, the libraries of half the world were destroyed in the fires of battle and in the fires of hate and fanaticism. Where they were spared physical damage, they were impoverished by isolation. There is an urgent need—*now*—for the printed materials which are basic to the reconstruction of devastated areas and which can help to remove the intellectual blackout of Europe and the Orient.

There is need for a pooling of resources, for co-ordinated action in order that the devastated libraries of the world may be restocked as far as possible with needed publications. The American Book Center for War Devastated Libraries, Inc., has come into being to meet this need.

The American Book Center is collecting and shipping abroad scholarly books and periodicals which will be useful in research and necessary in the physical, economic, social and industrial rehabilitation and reconstruction of Europe and the Far East. The Center cannot purchase books and periodicals; it must depend upon *gifts* from individuals, institutions, and organizations. The requirements are stated as follows:—

"*What is Needed:* Shipping facilities are precious and demand that all materials be carefully selected. Emphasis is placed upon publications issued during the past decade, upon scholarly books which are important contributions to their fields, upon periodicals (even incomplete volumes) of significance, upon fiction and non-fiction of distinction. All subjects—history, the social sciences, music, fine arts, literature, and especially the sciences and technologies—are wanted.

"*What is not Needed:* Textbooks, out-dated monographs, recreational reading, books for children and young people, light fiction, materials of purely local interest, popular magazines such as *Time, Life, National Geographic*, etc., popular non-fiction of little enduring significance such as Gunther's *Inside Europe*, Haliburton's *Royal Road to Romance*, etc. Only carefully selected federal and local documents are needed, and donors are requested to write directly to the Center with regard to specific documents.

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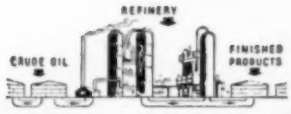
How Science Works a Miracle i

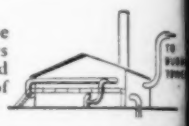
OIL'S "House of Magi



If you were to visit one of Imperial Oil's seven Canadian refineries, it would be like stepping into a veritable "*house of magic*". Natural crude oil is piped in at one end, and after many complex processes comes out in the form of more than 50 different products, ranging from chemicals for synthetic rubber and gasoline and oil for cars, to wax for candles and asphalt for roads!

You begin to see how this miracle happens when you look at a kettle of boiling water. As everybody knows, water has a boiling point of 212° Fahrenheit. At this temperature it gives off steam, which can be condensed to form distilled water.

Crude oil, however, is not a pure substance like water. It is a mixture of many different chemical compounds called "hydrocarbons", each with its own particular boiling point. As a result, when crude oil is heated, it gives off a succession of vapors as the temperature is raised. By keeping the vapors separate and condensing them, crude oil can be broken up into gasoline, kerosene and other oil "fractions".



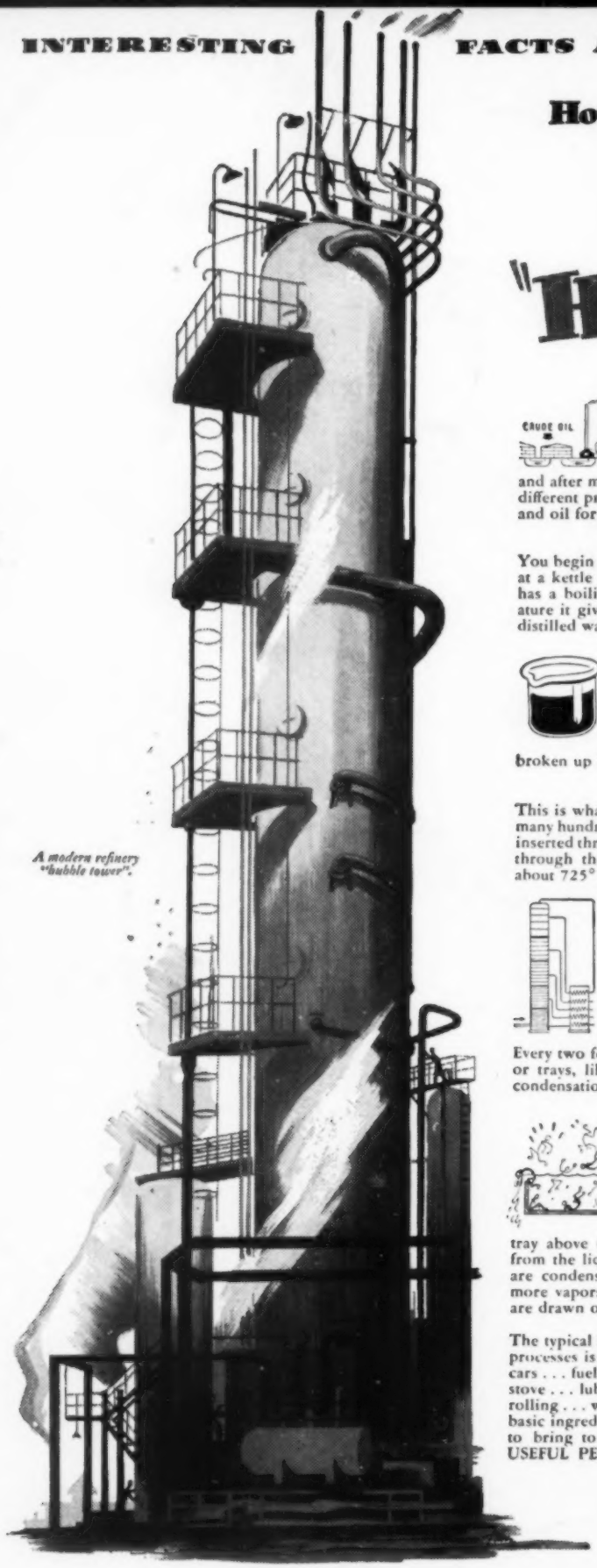
This is what oil men call a "pipe still". Inside are many hundreds of feet of steel pipe heated by burners inserted through one wall. The crude oil is pumped through the pipe and raised to a temperature of about 725° F. It then enters the "bubble tower".

This is a simple diagram of a bubble tower. It is a tall steel drum in which the heated crude oil is separated into its various "fractions", which are drawn off through openings in the side. The bubble tower is very hot at the bottom and comparatively cool at the top.

Every two feet or so up the tower there are large steel discs or trays, like big pie-plates, containing liquid formed by condensation of some of the hot oil vapors.

This shows how the trays work and what happens inside a bubble tower. The hot oil vapors rise from the tray below and bubble through the liquid in the tray above (hence the name, "bubble tower"). The light vapors, escaping from the liquid, rush upward to higher trays. The heavy vapors, however, are condensed and carried off in liquid form through pipes. More and more vapors are condensed as they pass through the trays higher up, and are drawn out through the sides of the tower at various levels.

The typical Imperial refinery, with its bubble towers and other fascinating processes is truly "a house of magic". Out of it comes gasoline to power our cars . . . fuel oil to heat our homes . . . kerosene for the farmers' lamps and stove . . . lubricating oils to keep the wheels of industry and transportation rolling . . . waxes for floors . . . asphalt for roads and airport runways . . . even basic ingredients for Miss Canada's cosmetics. All the crude oil is utilized to bring to modern living a total of MORE THAN 500 DIFFERENT USEFUL PETROLEUM PRODUCTS!



A modern refinery "bubble tower".

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IMPERIAL
PRODUCTS

IMPERIAL OIL LIMITE